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SCIENCE FICTION AND FACT

SEPTEMBER 2006

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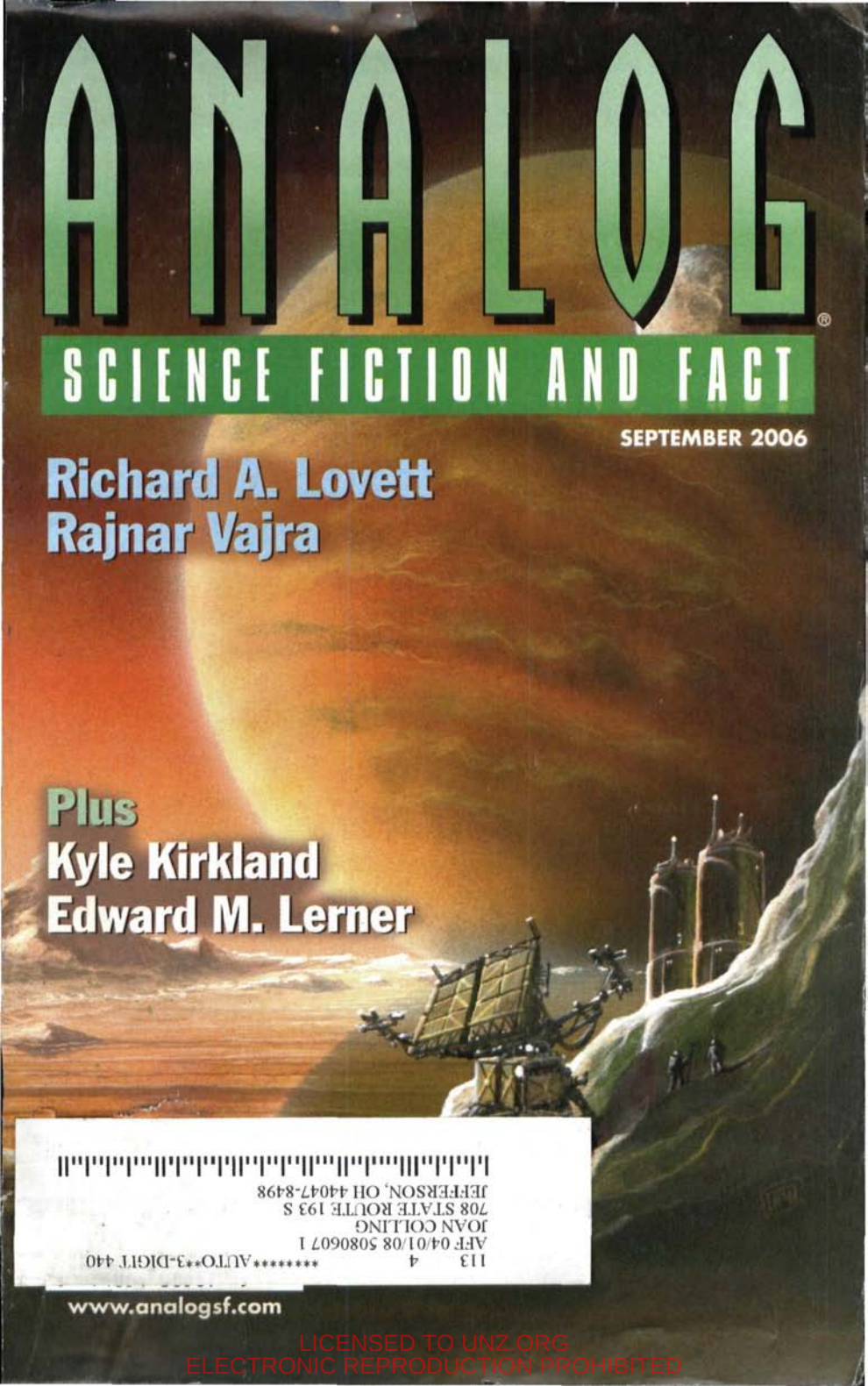

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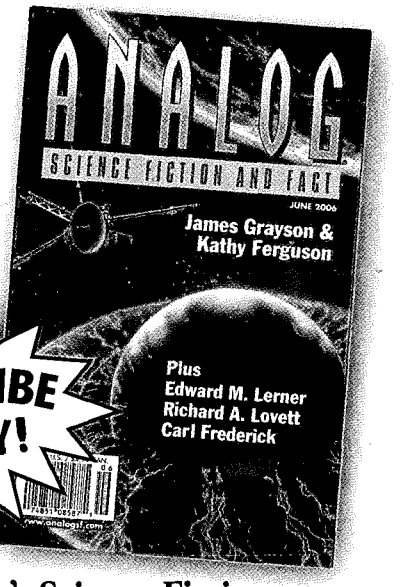

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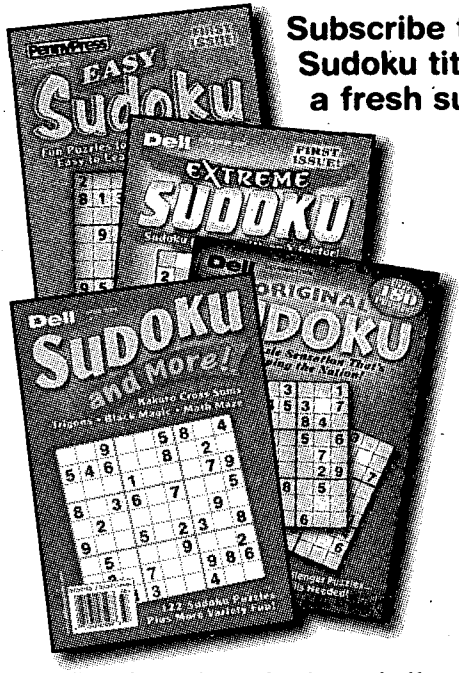

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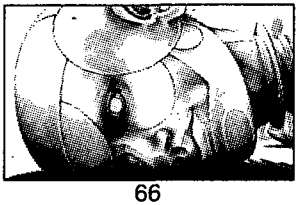

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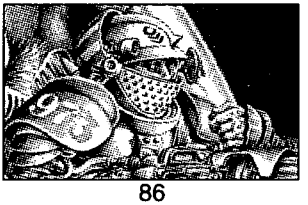

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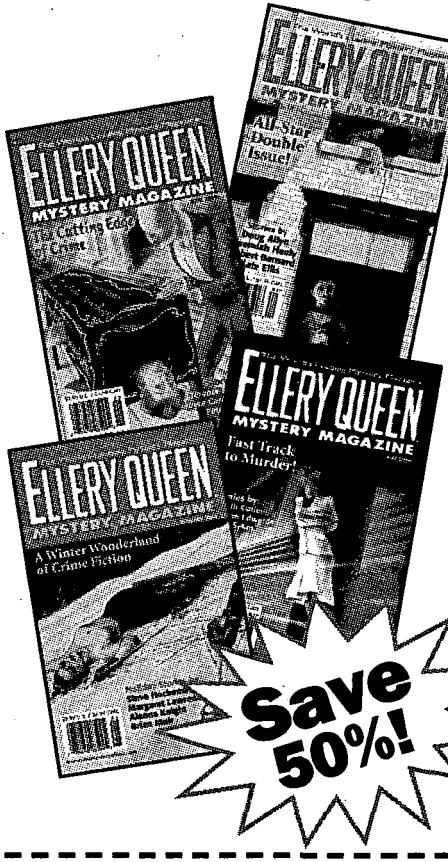

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EDITORIAL Stanley Schmidt

SCIENCE, JOURNALISM, AND RESPONSIBILITY

"ALL CLONED STEM CELL LINES ARE FAKE, INVESTIGATIVE PANEL SAYS."

When I saw that Associated Press headline, shortly before the end of 2005, my first reaction was, "I don't believe it." My second was, "How could they possibly know? Even if the ones they know about are fake, there may be some that they don't know about."

What the article under the headline actually said was both more believable and less provocative—but not every reader of a newspaper actually reads every article. Most of them skim headlines first to decide which pieces interest them enough to invest time in reading the actual text. In this particular case, the subject of the article was a panel at Seoul National University, in South Korea, investigating claims by stem cell researcher Hwang Woo Suk that he had produced 11 cloned stem cell lines tailored to individual patients. The panel concluded that he had not.

Reporting research results that were not actually obtained is, of course, a serious breach of scientific ethics and does science itself a disservice on several levels. But there's a big difference between one individual's committing such an offense, and discrediting an entire field of research.

Which, I suspect, is how many readers interpreted that headline: that all cloned stem cell lines—not just one set of them, in one misbehaving lab—are fake.

That is, after all, what it says. And many of those who read it that way never bothered to read the article itself to see what it was really talking about.

That isn't good, either. Scientific policy is shaped to a considerable extent by public opinion, and even more by the opinions of legislators and politicians. So those who understand the importance of scientific research and want to see it flourish can't afford to have those opinions shaped by inaccurate and misleading headlines. The Seoul incident is a particularly pertinent example because stem cell research, despite its huge potential benefits, is highly controversial, especially in this country. A headline that suggests that the whole field is inherently fraudulent or otherwise tainted can hardly help its chances of gaining acceptance and support.

You may object that this headline was not intended to suggest that, and I am not accusing anybody of trying to create that impression—but the effect, not the intent, is what ultimately matters. You may further object that only a careless reader would draw that conclusion from the headline, but surely I don't need to point out that the world is full of careless readers. Since they have the same voting rights as careful ones, responsible journalists need to do whatever they can to minimize the likelihood that they'll be misconstrued by anybody.

I'm all too aware that they can't completely prevent that from happening. Anybody in a position like mine sees abundant evidence that *somebody* will misconstrue virtually anything you say,

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no matter how carefully you say it. I'm particularly sensitive to the challenge headline writers face. A tag line limited to a dozen or fewer words can't realistically hope to fully and accurately convey the meaning and connotations of an article containing hundreds or thousands of words. But it is possible to choose those few words to convey as much of the essence and as little that invites misinterpretation as possible. This headline, for example, could have given a much clearer suggestion of the article's gist by simply changing two words, without changing the word *count* at all:

"RESEARCHER'S CLONED STEM CELL LINES ALL FAKE, INVESTIGATIVE PANEL SAYS."

Why wasn't that done? Obviously I'm in no position to know, but I can make some educated guesses. Last I heard, it was common practice for newspapers to employ one set of people to write stories, and a separate set to write headlines for stories written by the first set. Presumably this practice got established for reasons, which may have been valid then and may still be valid now; but it might be worthwhile to reconsider from time to time the question of whether that's really the best way to do it. It's true that condensing the essence of a story into a very few words is a special skill not necessarily possessed by all reporters. But it's also true that the reporter who wrote the whole story is more familiar with its content than any headline writer who has to digest and distill many stories quickly is likely to be. That familiarity may give him or her a better feel for what parts of the story are most important. Should reporters write their own headlines, or at least have veto power over those written by someone else? I've sometimes thought so, especially in extreme cases where I've read headlines that actually contradicted the stories over which they appeared. Newspaper people are, of course, routinely under extreme time pressure—but I can't help suspecting that there may be a better way to divide the labor.

I am not even remotely suggesting, of course, that journalists are solely responsible for giving the public a realistically favorable view of science. Scientists themselves have the first responsibility: to *deserve* a good public image by carrying out their work conscientiously and with integrity. Most of them realize that and do so all or most of the time, but some have lapses, most often small, sometimes large. Sometimes they remind one another of this. The June 9 issue of *Nature* (half a year before the headline with which I began) carried an article titled "Scientists Behaving Badly," about the prevalence of questionable research behavior ranging from falsifying data (very serious and fortunately rare) to sloppy record-keeping (commoner but far from prevalent, less egregious but not insignificant). The article examined some of the factors that

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lead scientists into temptation, and what might be done to alleviate them. The most important preventive, of course, is that scientists themselves must remain conscious of their responsibilities and police themselves, and the *Nature* article is one example of an "inside" way of doing so.

The public needs to understand that scientists are human beings, not infallible, and not interchangeable. Some are much more or less capable, conscientious, or unscrupulous than others; but the extremes are unusual. If the public is to understand how and by whom science is done, it must not be led to believe that one individual who commits serious offenses is typical of all scientists, or any particular field of research. Creating such an impression, intentionally or otherwise, can easily cripple or even nip in the bud an infant field with big potential.

A fairly recent example in which that may have happened is "cold fusion," or "chemically assisted nuclear reactions." (See "Cold Fusion Conundrum," January 1995.) There may or may not be something that we need there, and we may never know because the "scientific mainstream" quite early decided there wasn't and systematically squelched further serious consideration of the possibility—at least partly in reaction to a university administration's premature eagerness for publicity and media willingness to hype a "maybe" before anybody knew much about the reality.

Journalists aren't all alike, of course, and many do strive for accuracy and balance. But neither are scientists all alike. Some lie, cheat, or go off half-cocked, but most don't; and the public—and its elected representatives—need to know that. But who's going to tell them? Most scientists seldom talk directly to the public; they depend on journalists to give laymen—on whose support they depend—a clear and accurate idea of who they are, what they do, where problems lie and where they don't, and why their work is important (but without building up false hopes or fears). Journalists—whether writing body copy or headlines—need to report all this as carefully and accurately as they can. And scientists need to help them by taking time to make sure they have it straight in the first place. ■

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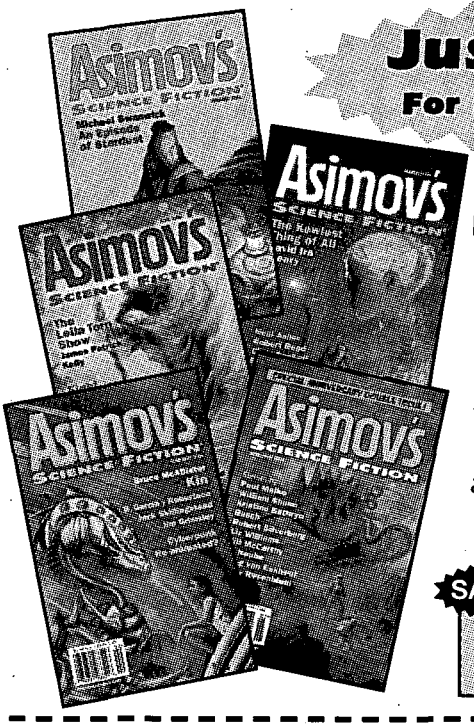

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A Pound of Flesh

Richard A. Lovett

Is honesty *always* the best policy?

The day got off to a bad start when I put my wife's MemriDrops in my eyes. At least, technically she's still my wife. I guess I should call her my soon-to-be-ex-, but that sounds as bad as it feels.

Mornings have never been my thing, and with Marion's departure I find it hard enough to get to sleep at night, let alone climb out of bed in the morning. You know how it feels when you try to sleep in, only to discover that once you've prodded yourself out of bed, you can't really get moving? That's how it is with divorce. The more time I pretend to sleep, the less I'm required to be awake—which is a good thing, especially because, all too often, there doesn't seem to be much of anything worth *doing* when I'm awake. Which is a separate problem, but I'll get to that in a moment.

Even though they must have been nearing expiration, the 'Drops firmed up into contact lenses just fine. But I was slow to realize they were the *wrong* lenses. Halfway downstairs, I started getting that stepping-off-a-curb feeling that comes when your eyes insist your legs are three inches too short.

In the kitchen, the AutoPot was perking, so I thought I'd wake myself a bit before dealing with the eyes. Bad idea. My arms didn't feel any closer to the right length than my legs, and I wound up spilling the pot's contents all over the counter in an overshoot/undershoot effort to hit the mug. It might have been comical if all that hot coffee hadn't trickled down and caught me where it really hurts.

There's one good thing about pain: it wakes you up even better than caffeine. I yelled, cursed, and with remarkable accuracy for a man whose depth perception wasn't working, turned and

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threw the mug through the vidscreen, where a perky newscaster with a voice too similar to Marion's was reciting today's pinpoint forecast. "On the West Side, the waterfront will see brief showers at 9:15, 11:20, and 12:45—" she managed to say before my lucky shot found its mark, terminating not only her broadcast, but my favorite mug and a bunch of electronics I could ill afford to replace.

"Damn you, Marion!" I roared into the silence. "Why didn't you take those stupid 'Drops when you took everything else?"

Another problem with divorce is you think everything's a conspiracy. Professionally, I've dealt with enough divorces to know all about that, but for the moment I was sure Marion had left the 'Drops as a booby trap and was now sniggering at me for breaking the vid.

Meanwhile, my own 'Drops were in the medicine cabinet and my vision wasn't going to improve on its own. I stumbled upstairs and rummaged for a bottle of Erasure. Even the big print on the label was hard to read, but I was awake enough now to find the right bottle by shape, without compounding my problems by squirting something nasty into my eyes, like rubbing alcohol or sunscreen.

When I could see again, I located my own 'Drops—and chose the Baby Blues, whose bottle, I realized, was the same color as Marion's.

And suddenly I knew why she'd left it. A few years ago she'd gone on a togetherness binge and matched several of my eyeshades, with the idea it made us look more like a couple. I'd thought it silly, but that's the way I've always been about most of that "togetherness" stuff. She was a romantic; I'm strictly utilitarian. I've got a variety of eyeshades, but all for practical purposes. Today, I wanted the Baby Blues because the rent was due and I needed that frank, innocent gaze when I begged for Extension.

Sadly, the rent wasn't my only problem. If someday soon I didn't come up with enough to pay my lawyer's retainer, Marion would clean me out and the rent nano wouldn't be the only one to come home to roost in ways that might almost make me wish I'd just poured bleach in my eyes and gotten it over with.

Still, the rent was today's concern. A few minutes later my landlord proved it by intercepting me on my doorstep.

"Sorry, Trevor," I said, practicing my innocent gaze. I'd planned on calling him for an appointment later in the day, but I already know my spiel. "I'm expecting a nice fee, but it's been delayed. Can you give me a week's Extension?" Actually, I'd not seen a paying client in a fortnight, but a week was the most I could ask for with a straight face. In the back of my mind, I was trying to remember the terms of my lease. Landlord/tenant law requires the enforcement nano to be non-lethal and non-maiming, but that leaves a lot of room for unpleasantness. When I'd accepted it, I'd been more than marginally solvent. Marion was a computer tech whose career seemed immune to the forces that had ruined my own, and I hadn't paid much attention to the fine print. If I were lucky, I'd simply agreed to turn blue or have "deadbeat" appear on my forehead in neon tones. But I might have accepted a month of diarrhea, an ugly skin disease, narcolepsy, Tourette's syndrome, or any of a host of other legally permissible ailments that merely make you *wish* you could die. Too bad Trevor hadn't insisted that Marion accept the nano, too, because now she was the one with the money while I was the one stuck with the nano. It wasn't fair—but who's ever seen a divorce that was?

Trevor had chosen a stern, dark look: his bill-collector persona. Actually, he's a pussycat who's given me a lot of slack, but he has his own nanos to tend to, and property taxes were due sometime

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soon. Getting the government to give you Extension is damn near impossible.

"Blast it, Alex," he said. "You know I like you, but I need the rent. Preferably on time."

I shrugged. "Tell that to my client. I gave him Extension, but that means I need it from you." A total fabrication, but I was getting desperate. *What* had been in that rent nano?

Trevor was still trying for stern, but I could see the softness around the edges. "Come on," I wheedled. "Just a week."

"Twenty-four hours."

"Five days?"

"Three."

"Four?"

Sometimes, I push too hard. It was one of the things Marion complained about. "Three," Trevor said. "And count yourself lucky." He tapped a trio of triangular pills from a packet labeled RENT EXTENSIONS and slid them into a pill-sized envelope. It amazes me that he dispenses Extension this way, rather than just reprogramming the nanos with a code-locked scanner. Maybe he doesn't trust scanners, even though they're pretty much the same devices the bank uses when you log a payment. Or maybe he's just old-fashioned. After all, he's willing to visit tenants in person, rather than hiding behind a rental agency that would never give even a day's Extension.

Briefly I wondered how many pills were in his packet and what would happen if someone got really desperate. Then I decided it didn't matter because the number was finite and eventually the clock would run out. Still, I wouldn't flash something like that around when rents were due. Maybe it's just my profession that makes me cynical, but Trevor is too trusting.

I started to thank him, but he interrupted. "I mean it," he said. His normally open face clenched and I realized that even pussycats have limits. "Don't even think about trying to tell me you lost one. Three days, or you can just rot."

Not *rot in hell*. Rot. As in a literal threat. Had Trevor once talked rich, complacent me into some kind of flesh-eater? Perhaps because he knew he was a pussycat and needed a big gun to back up threats he didn't want to enforce? The worst of those were reserved for the IRS, but commercial ones could be pretty nasty—muscle atrophiers, rashes that deprived you of a month's sleep. Gads, the prospects were endless.

My office is a dive. Once upon a time, I had digs in the financial district, back when I was a junior partner in the law firm of Lorencz Biggle Tracy & Epstein. My 43rd-floor window office had been only a mile from here on the map, but infinitely removed in the hierarchy of what-you-can-afford. Now Alexander Copley, Private Investigator, operates out of a hole-in-the-wall in Old Town, domain of drunks, derelicts, and druggies.

Ours is one of several cities whose Old Towns boast of being the original Skid Row. Here, in the ancient logging capital of the Northwest, the term had a literal meaning: Skid Road was where timber was "skidded" into the river to be lashed into rafts for shipment downstream. Today, rather than being an embarkation point, it's where everything fetches up when it hits bottom, including yours truly. Rents are low, nanos mild to nonexistent, and if there's any mystique to being a PI, having your office in the most disreputable part of town doesn't hurt.

The first order of business was caffeine. I scooped a healthy dose of instant coffee into a mug—no fancy AutoPot for the office—added water, and popped it into my economy microwave: you know, one of the mini- ones that convenience stores use to nuke stale hamburgers into a semblance of edibility. Mine wasn't a whole bunch cleaner than those in the convenience stores. Someday, I really should do something about that, but I figure that each time I

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turn it on, the radiation kills anything nasty growing inside. Or maybe I'm creating mutant superbugs that will someday take over the world. As far as I'm concerned, they can have it. Let *them* deal with the nanos.

I should have seen the writing on the wall when I read about the first nanocontracts in the *Bar Journal*, but who in their right mind would put their *bodies* up as collateral?

People take worse risks with loan sharks, though, and nanotech is a lot more respectable. Suddenly you couldn't even get a charge card without a nano. The first profession to suffer were bail bondsmen. Who needs bail if suspects can simply be given a nano nasty enough to guarantee they'll show up in court? For the same reason, prisons needed fewer guards.

Soon, civil lawyers were also feeling the pinch. Nanocontracts still leave room for squabbling, but unless a court intervenes and orders Extension, they'd better be *brief* squabbles. Not the type that make attorneys rich. Then the insurance lobby pushed through the Tort Reform Nanobot Bill, which required plaintiffs to accept a nano before filing suit. Anyone could still have their day in court, but if you didn't win, you didn't receive the antidote. Frivolous lawsuits weren't the only ones to disappear—and with them went the bread-and-butter work of defense attorneys like me.

By the time Lorencz Biggle, etc., were showing me the door, I was even hearing of nano-wills in which heirs had to take nanos before the reading of the will. Those who declined waived their inheritance; the rest could only obtain Release by agreeing not to contest the will. It was brutal but effective, and suddenly another class of attorneys was out of business.

In Shakespeare's *The Merchant of Venice*, the moneylender Shylock makes a loan to a man he despises. There are many things he could have sought as collateral, but what he wants is the option to extract a pound of flesh from the debtor's chest. The borrower, secure in a successful business, accepts this barbaric term, but ships sink and Shylock forecloses. Then, at the last moment, he is stymied by the fact that his contract said nothing about blood. He can seize his pound of flesh, but if he sheds one drop of blood in the process, he will be charged with murder.

What Shylock needed were nanos. Off-the-shelf varieties aren't *that* nasty, but custom jobs can do just about anything. Fatal flesh-eaters are illegal except as bail for violent felonies, but if you're stupid enough to accept one, you're going to be more interested in getting the antidote than reporting it. Today, anyone with the money for black-market nanos can be Shylock.

Waiting for the water to heat, I scooped old mail from the table where I'd deposited it yesterday, flipped junk mail into the trash, and tried to decide whether to open the telephone statement. At least it didn't involve nanos. I'd opted for the pre-pay alternative, but that still gives the phone company plenty of leverage with the old-fashioned threat of simply turning off the service.

My PI business had never turned a profit. The sad fact was that two out of every three attorneys were out of work and I wasn't the only one thinking that years of trial preparation might have taught me something about investigation. My main hope was that if I waited long enough, most of the competition would starve out.

Still, I hadn't been losing a lot of money, so when necessary, I'd made it up from Marion's and my savings. Then she moved out. A week later, irony of ironies, she hired a hotshot attorney who froze the savings account so I couldn't spend any more of it until she got her share. If my own attorney was as good as he claimed, some of that money would eventually be mine, but it would be a long fight and meanwhile I

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was living hand-to-mouth.

Pretty soon, I'd have to take the first of Trevor's little pills. In theory, I could hire someone to reverse-engineer the fulfillment code and make as many as I wanted—in Old Town, you can find people with some pretty arcane skills. It's another reason Trevor is too trusting. But if I had the money for that, I could pay the rent, so why bother? And there are some nasty rumors about what happens when fake Extension meets a nano that can tell the difference.

Better would be to delay taking the first pill as long as I dared, then stretch the interval between them, hoping there was enough safety margin to gain me an extra day or so. I was getting desperate enough I might actually try it.

I swiveled my chair, ignoring its squeak of protest. If I ever get rich, I'll buy a new one, but that's not exactly a high priority. Leaning back, I propped my feet on the bookcase that doubled as a credenza and stared through what passed for my window on the world.

It really was a window, although the little daylight it yielded came from a ventilation shaft that provided even less ventilation than light. What it did offer was a view of the opposite wall, built eons ago of honest-to-goodness bricks. If we ever get the earthquake the doomsayers fret about, all those bricks will probably peel off and tumble below in a giant pile that will make me glad I'm on the fourth floor, even if half the time I have to walk up because the elevator's on the fritz or just too damn slow. Life sucks, but hey, if it all comes crashing down, I'd rather be on top of the pile than under it.

Some people work crossword puzzles when they have nothing better to do. Me, I count bricks. The trick is to get the same number twice in a row. Some days, I can kill hours before I manage it. Yesterday, I'd tallied 413 on the first attempt and 415 on the second before getting two repeats of 416. Today I had a slightly different angle, so the number would be different.

I was on my third recount—something on the order of 435 seemed to be today's tally—when there came a knock on the door.

I don't get many visitors. Most of my clients are referred by Lorencz Biggle, where a few of the survivors do what they can to help keep me from starving. But those referrals are always preceded by phone calls, and the phone hadn't been disconnected—yet. This had to be someone who'd tracked me down from what little advertising I could afford.

Walk-ins rarely amounted to much, but still, it paid to look like I had other work.

"Just a moment," I called.

I scritched my chair back into alignment with the desk, woke up the computer, and was pulling a couple of files from a drawer when my client lost patience and walked in.

My first thought was that she looked out of place—and not just because she was a she. Plenty of women venture into Old Town, though usually not in snappy business suits or carrying those discreetly elegant attaché cases that are the first and most useless purchases of on-the-make junior attorneys.

Even in the financial district, her attire would have rung false. I'd served a stint on Lorencz Biggle's hiring committee, and there's a big difference between the jobseeker and the jobholder. This woman had dressed to impress, but the jacket, blouse, and black leather pumps were no more natural to her than being in Old Town. The ensemble was too perfect—as though she'd gotten it from a store clerk whose idea of lawyers was based solely on vid shows—but her hair flowed across her shoulders in a fetching style that mixed poorly with the crisp formality of her wardrobe. She was older than my fledgling attorneys—somewhere in her thirties, with body language that spoke of

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self-assurance, and poise that clashed with the job-interview attire.

Whatever she normally did, she'd been doing it long enough to take it for granted that she was good at it, but the business power suit wasn't part of it. I wondered why she felt the need to impress the likes of me. Not that I was in a position to be picky.

"Mr. Copley?" Her voice was another conundrum: crisp, self-assured, polite—but, like the hair, too feminine for executive-standard. I was reminded of Marion's computer-geek friends, happiest in blue jeans and running shoes, but sometimes forced into greater formality for a wedding or the theater. She was rather pretty in a dark-skinned brunette manner—which, I admit, has always been my type.

I pushed aside the still-unopened files in a move I hoped rang more true than her attire. "Call me Alex."

Her handshake was firm but damp, producing an odd, almost electric tingle as our flesh met. Highly disconcerting. Was I so starved for female attention that a *handshake* was giving me the shivers? I suppressed an urge to wipe my palm on my pants leg, and gradually the tingle diminished. "What can I do for you?"

"I have a problem," she said, "but first, what's your billing rate?"

It's one of those things people usually wonder about, though normally they're not so forthright. Again, I sized up the power suit and attaché case. Whatever message she intended to convey, she was making no effort to look poor.

"I usually charge $195 per hour plus expenses. But I can come down a bit for an interesting case."

It was one of those great lines that's sort-of true. That had been my minimum rate in my Lorencz Biggle days, and I'd done a lot more billing then than now, so the "usually" was almost accurate. *Almost* being the operative word. It was also the type of figure that ought to impress someone masquerading as a high-priced whatever-she-thought-she-was. Early in my PI days, I'd learned that you can more easily lose a client by citing a too-low rate than a too-high one because it makes them think you're incompetent. When they gasp and start for the door, you can always offer a discount. Then they think you're being generous.

But my visitor merely gazed at me. Her eyes swept the office, taking in the desk, the unopened folders, the brick-view window. When she looked back, I'd have sworn she was puzzled. "Really?" She looked around again. "Even in today's economy?"

She had me with that one. But her attire said money wasn't an object to her, so I wasn't going to let it stand in my way, either. "Yes."

For a PI, lying is an important job skill. It's not that I'm inherently dishonest; it's just that sometimes it pays to preserve wriggle room. But now, my cheeks burned and I found myself sweating.

She smiled tightly. "I don't think so. Could you work for, say $95 per hour?"

"That's kind of low," I said, but the sweating and blushing continued.

"In fact, I bet you'd work for $45."

This was the oddest negotiation I'd ever been part of. When she'd suggested $95, my heart had leapt because I'd figured we'd wind up somewhere in the middle, and if the job was big enough to be worth haggling about, it was going to be enough for me to deal with Trevor and the phone company and a few other things, as well. Offering $95, then dropping yet again was the weirdest tactic I'd ever heard of.

"That's really low," I said.

"But would you do it?"

I gulped. How could I get her back into triple digits? "No," I said, and again found myself blushing and sweating.

"I thought so." She made it sound as though I'd accepted. "But I'll give you $1,600 a day, with the understanding that overtime is on you. No nanos,

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though. I'd rather do it the old-fashioned way."

I nodded encouragingly. In theory, an exchange of nanos would work to both our benefits, forcing me to perform and her to pay. But unless you want to go completely black market, there end up being records of payments, extensions, and releases. She wouldn't be the first client to prefer cash.

"No problem, but I'll need an advance."

"Of course. What do you say to a week's pay as a retainer, with additional installments as you do the work?"

What I'd say was something on the order of "Halleluiah!" but I wanted to preserve what was left of my dignity. "That sounds fair," I said, and for once, I didn't blush.

"More than fair, since you would have taken $45. But before I tell you how I know that, how good are you at keeping secrets?"

"Very." That's something else that comes with the Lorencz Biggle background. Every attorney learns early on the importance of client trust.

Again, she made me feel as though I were under a microscope. Then she smiled, and for a moment, I might have been seeing a trace of whatever lay behind the falsely corporate exterior. Something warmer and a bit more playful. Or maybe she was just happy she could trust me—though I was baffled why she believed that when she hadn't believed the $95. Maybe she was simply a nice girl, about to get divorced and tired of acting tough. *Yeah, right. A rich nice girl, looking for a way to stick it to her husband.* Then I squelched the thought. I couldn't afford to cast my only client in Marion's image.

Divorces are another arena in which lawyers have suffered: nanos add new meaning to the term "iron-clad prenuptial." But in many cases, all that's done is shift the battleground from the lawyer's office to the streets. To the extent I have a bread-and-butter business, it's staking out soon-to-be-divorced husbands or wives in the hope of finding evidence for a court order neutralizing the nuptial nano. It's easy work because cheating spouses can be incredibly sloppy. Maybe tempting fate is part of the lure or maybe they're like teenagers and really don't think anything nasty could happen to them. Either way, it's fun to watch their faces when they're confronted with the evidence and realize they have old-fashioned, expensive legal fights on their hands. Just like I do, though in my case it's because Marion's and my marriage predated nanos.

"Anything you tell me is completely confidential," I added.

"I know." The smile vanished and she was again the faux-whatever. She snapped open her briefcase and pulled out a prepaid credit chit. "Is your computer set to read these?"

"Yes. But don't you want to tell me what this is about, first?"

"Not until I have you on retainer. Just in case you were playing word games with me about confidentiality." She gave me the barest hint of the smile. "Like you must have been about your 'usual' fee."

I logged onto the banking web, then let her plug the chit into my computer's credit-acceptance slot. She used her own keypad to authorize the deduction from what must have been a sizeable balance, and milliseconds later, $11,200 was in my account.

"That's seven days," she said. "Until this is over, you're working for me every day. Report at least once a week, never lie to me again, and you get another week in advance each time, until we're done or one or the other of us gives up. If, after I've explained it, you don't want the case, you can return the retainer—minus a suitable sum for the next few minutes. Are you okay with that?"

I nodded, mesmerized by that $11,200 figure and the thought of more, just like it. "Normally, the consultation's free," I managed to say.

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"That's okay. It's worth it just to find out how you fooled me. Now, tell me, how can $195 be your 'usual' fee, when I know you'd take a lot less?"

I thought about trying to dodge the question, but she had me thoroughly unnerved. Besides, with money in the bank, I could afford to be at least vaguely honest.

"Prior life," I said.

She nodded as though that made perfect sense. "It had to be something like that."

"So what's this about?"

She leaned forward in my guest chair and tugged her skirt down toward her knees—one of those "modest" gestures that have the reverse effect of drawing attention to itself. I've never been sure whether women know this, and on the off chance they don't, I've never wanted to be the one to enlighten them. With difficulty, I prized my gaze back to her face and waited for her to begin.

"My name is Megan Fordham," she said. She pronounced it Mee-gan. "I work for a small nanotech company: an outfit called SNS. Once upon a time, that meant Southern NanoSystems, Inc., but now it's just SNS. Unless you're an industry insider, I doubt you've ever heard of us."

I shook my head. Nano-providers are like chip manufacturers. There are a few big ones and a host of little ones.

"We make custom nanos," she continued. "Suppose you wanted one that would produce the symptoms of poison oak. Not just some generic itch, but honest-to-goodness poison oak, medically indistinguishable from the real thing. Why, I haven't a clue, but we're the type of company you'd turn to.

"A couple of years ago, we began experimenting with highly time-sensitive nanos: ones you might give to chronically late employees to get them to work on time. The idea was that each time they came to work, they'd use a device like a time clock to reset their nanos for next time. We actually had an asthma nano that worked nicely—you'd start wheezing within about five minutes of schedule. But we never figured out what to do about sick days. Sure, you could use a remote reset for anyone who called in sick—just like the scans the banks use when you pay your mortgage at an ATM . . ."

She continued talking, but her mention of mortgages had reminded me of Trevor. Soon, I either needed to get to an ATM myself or take one of his pills. Briefly, I took inventory of my body. Nothing itched. Nothing ached that didn't normally ache. For the moment I seemed okay, and I really didn't want to start gobbling Extension in her presence.

Luckily, another of my skills is tuning out without letting anyone realize it, and I didn't appear to have missed much.

". . . not really ill?" she was saying.

The question appeared to be rhetorical, so I grunted and, reassuringly, she continued. "That was the end of that project. But it got us thinking. Was there a way to differentiate phony sick calls from the real thing? When the body is under pressure, it makes chemicals called stress proteins. It also produces various neurological responses, all chemically triggered.

"It didn't take long to realize we were onto something a lot more valuable than a tardiness nano. What our research was leading to was a lie detector that could be linked to any effectuator we wanted. Combined with an asthma nano, for example, it's a pretty powerful incentive to tell the truth. The version you got simply makes it easy to tell when someone isn't."

"Wait a second. Are you saying you slipped me a nano?"

She ducked her head but didn't look particularly repentant. "Yeah, I know it's illegal. The nanos were on my hand when you shook it, and enough to do the job were in your bloodstream by the time you said hello. Want to give back

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my money?"

"Not yet."

"I didn't think so. Besides, what the law is really concerned about is giving harmful nanos without permission. This one didn't hurt you. All it did was make you flush. I know I told you not to, but go ahead, tell me a lie."

"Such as?"

"Anything. Tell me it's raining."

"It's pouring." I said it as calmly as possible, but sweat broke out on my forehead, and again I felt my cheeks redden. "Wow. How long does it last?"

"The flush? Only a few seconds. The nano itself wears off in a few hours, though we could have made it last forever."

"So you're telling me you've developed a nano-based truth serum."

"Not a truth serum. A lie detector. A truth serum would force you to speak. This merely shows when you're lying. And it's not perfect. A good liar can hide parts of the truth without triggering it—as you did when you told me about your 'usual' billing rate. And if you really believe the moon is made of green cheese, it's going to register as truth. It's probably also useless on pathological liars."

"That's all very interesting, but what's it got to do with me?"

"I was getting to that." She tugged again at the skirt, though as far as I could tell, she was showing no more leg than before. "Our lead scientist is Darryl Marnier." She pronounced the first name as Darr'l and the last in the French manner, as Mar-nee-ay. Must be a Southern thing, though for all I knew, the "southern" in SNS meant California. "Or maybe I should say he *was* our lead scientist. He's vanished. I'm hoping you can track him down."

"Uh-huh," I said, thinking about the nano and what I could and could not get away with promising. I'd done my share of missing persons work, but it was mostly heir searches or hunts for runaway kids—depressing work because all too often I wasn't doing the parents any favor. *Hi, here's your drug addict back. You owe me another $500. See you again, next time she runs away.* Contrary to what you see on the vid, PIs don't get many chances to hunt for adults who want to stay disappeared.

Still, how hard could it be? It's almost impossible to live without generating a gazillion electronic footprints. With the nano reading my mood, though, I didn't want to sound too optimistic.

Fortunately, *uh-huh* appeared to be truthful enough.

She paused a heartbeat, then continued. "I'm worried about him. We were coworkers and . . . friends." She blushed, and I realized that the nano must work both ways. How intriguing. She tugged yet again at the skirt and I decided not to embarrass her by pressing for details. Senior researcher Darryl. Beautiful whatever-she-was. I could connect the dots. I'd seen it often enough in my divorce work.

"Married?" I asked.

She looked puzzled. "No. I'm single."

"Not you. Him."

She shook her head. "I told you, we were just friends." But she blushed again, and sweat was beading her brow. I tried to feel sympathy, but having been the victim of the truth gizmo, what I felt was vicious delight. Still, she was paying me a lot of money, so I again let her off the hook.

"What I meant was, is there anyone other than you who'd miss him?"

She was still blushing, but composed herself nicely. "Well, the whole company does. That's why I'm here. The project can't proceed without him, and the president, Graham"—she pronounced it Gram—"figured I'd be extra-motivated to find him." The blush deepened and I wondered why she didn't just come out and tell me they were lovers. Did she really think I'd care?

"But you already have a perfectly good truth nano."

"Sure. And we can clone as much of it

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as we want. But Darryl never made an antidote and wherever he went, he took his lab notes with him."

"Why don't you just reverse engineer an antidote?"

"Because Darryl used a 96-bit encryption code." She read my look, sighed, and leaned back. "Look, you know how nanos work, right? Each has two codes, one for Extension, the other for Fulfillment. Sometimes three, if it's for a recurring obligation that you want to be able to reset without terminating."

"Like a rent nano," I said, my mind again wandering to Trevor's little envelope.

"Right." She hesitated, probably trying to assess how stupid I was.

I tried to look smart, but in her field, the answer undoubtedly was *very dumb*.

"Most nanos use a 24-bit code," she said. "That means there are about 16 million possibilities—good enough for most uses, but not for something you really, really want to protect. Darryl's code allows something like 10^{20} times as many possibilities. It would take forever to reverse engineer."

"So you're saying the nano's worthless without the code?"

"No. There are uses for which an antidote isn't necessary. We were going to call our product the NanoGraph and start by test-marketing it as a replacement for the polygraph. But our first big market would have been for trials. You know, 'I swear to tell the truth, the whole truth, and nothing but the truth—'"

"'—so help me, nano.'"

Again, a hint of the smile softened the corners of her mouth. "Something like that. You were a lawyer. You can see the value of it."

I certainly could. Lying witnesses are one of the banes of the profession. Though sadly, a truth nano would put yet more lawyers (and PIs) out of business, because you wouldn't need as much trial preparation. On cross-examination, you could do a lot with a single, all-purpose question: *Is there anything important you failed to mention?*

"So why do you need Darryl?" I hated to ask—what if I talked her out of hiring me?—but the more I understood, the better were my chances of finding him.

"You mean why do I want the antidote?" No trace of a blush. Either the nano was already wearing off, or she'd worded the answer carefully enough to steer it away from whatever extracurricular relationship they might have had. "It's not needed for formal settings like polygraphs or trials. But there are a lot of . . . let's call them *informal* settings, in which it would be nice if the questioner were more free to . . . *tweak* . . . the truth—and where the nano might have to be administered in ways that make it likely both people would be infected."

"Like you and me?"

"Among others." She didn't say *police interrogations*, but it didn't take much imagination to see how much the police might love such a thing. Would it be permissible under the Fifth Amendment? An effective, painless lie detector would raise interesting questions about why we have a right against self-incrimination. It's one thing to let the guilty clam up because we don't want the police beating confessions out of those who might be innocent. But do criminals really need an absolute right to their secrets? Part of me—the part that had been tricked into revealing my lowest, cut-rate fee—thought privacy was important. But another part liked the idea of being able to probe other people's secrets. And with the nano, you could ask at random whether people were terrorists or child molesters and immediately catch the ones who were.

"So why not just redesign it with different codes?" I asked.

Her sigh suggested that I'd fallen on the technological-intelligence scale from very dumb to whatever lies below. "That's not possible. Nanos are com-

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prised of two pieces: the detector and the effectuator. On most, the detector's not much more than a molecular clock, but for security reasons, you always make sure that it and the fulfillment codes are inextricably linked. That way, someone can't just clone your nano and peel off the codes. Unfortunately, it also means you can't peel off the detector from the codes. With the NanoGraph, the detector's the important part, and only Darryl knows how it works. Bottom line: you can modify the effectuator all you want, but you have to know the codes to do anything else."

Megan and I had a lot more details to go over, but there was one question she would be expecting me to ask, whether I wanted to or not. "Why me? There are a lot of other PIs out there."

"What makes you think you're the first I tried? Maybe you're just the first to meet my requirements."

"And those are?"

"Oh, several. You came well recommended."

I made a mental note to thank Lorencz Biggle.

"You're a smooth talker, but not so smooth you can evade the nano. Also, I know you really will keep things confidential. You wouldn't believe how many of your competitors flunked that one. Maybe they just blab to their wives or girlfriends, but I'd rather they didn't. As I understand it, you have neither, right?"

"Correct," I said, then remembered the nano. "Well technically, I'm still married. But we're not on 'blabbing' terms."

"Good enough. I want to find Darryl, but I don't want to risk one of our competitors getting wind of the project."

It wasn't the first time she'd said *I*, not *we*. Maybe Megan was a bit more than Darryl's lab assistant. Maybe she was the boss and *he* the beautiful assistant. Who just happened to be the brains behind the project? Nah. More likely they were peers and I'd been led astray by her looks and the fact that every time their relationship had come up she'd lied about something or other. I'd presumed it was just their romantic involvement, but was she clever enough to use an obvious lie as a smokescreen for a not-so-obvious one? Not that it mattered. It was a neat way to trick the nano, which wouldn't care whether you were telling one lie or a hundred, but if by holding back, she made my job more difficult, my fee would simply be that much larger. I could live with that.

Megan unsnapped her briefcase and handed me a small glass vial. "A sample. You might find it useful. A drop or two is all you need."

She spent another hour filling me in on details, but when she finally departed, my first job was to deal with my nanos. That required a trip to the credit clinic because even Trevor isn't naïve enough to allow his codes to be accessed by a non-secure machine.

Before leaving, I took one of his pills, just to be on the safe side, then dumped the envelope in a drawer. Damned if I knew the shelf life of his brand of Extension—it was another of those things I really didn't want to learn by experiment—but that didn't mean it made sense to throw away the pills.

As always at month's end, there was a line at the credit clinic, but eventually I reached the auto-tech machine, keyed a payment to Trevor's account, and stuck my arm into the machine's maw while the bank transferred the funds.

TRANSACTION COMPLETED, the screen flashed a moment later. THANK YOU FOR USING CREDIT CENTRAL. PLEASE WAIT WHILE WE EXTEND YOUR COMPLIANCE-ASSURANCE NANOBOTS. The ATM hummed to itself, flashed a series of status lights, and did whatever it does to reset my nanos so I don't have to worry about them for another month.

Except that I *was* going to worry.

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Hell, I was worried already. I paused, my arm still in the machine, even though it was now wishing me a good day.

"Hey man," a voice behind me said. "You wanna move it?"

"Just a moment."

Ignoring the ensuing theatrical sigh, I queried for a description of the nano and was informed it was mock ringworm, ten percent body coverage, six weeks' duration, intensity just below true medical emergency.

I tried to imagine ringworm as a near "medical emergency," and shuddered.

But I didn't have to live in dread. For the first time in months, I was solvent. The rent had dented my newfound lucre but I had a lot left, and it looked like that was just the beginning.

What if I went on the pre-payment plan? I'd have to check my lease to see how many months I'd have to pay in advance—probably at least six—but if I did, I could be rid of Trevor's nanos forever. No more arm in the slot. No more wondering what would happen if the damn thing malfunctioned and reset the little beasts for next Monday rather than next month. That isn't supposed to be possible, but I really hate having to trust so much to a machine.

Missing-persons work is mostly computer drudgery. For years it's been possible to track people via credit card charges, phone records, EasyPay toll passes—anything that leaves a swath across the cyber landscape. Getting that information isn't a matter of skill, it's connections—as in what databases can you access, officially or otherwise?

Thanks to my divorce work, my access is pretty good. Early on, I'd realized that as long as I was underemployed, it behooved me to take whatever work came my way—especially because there are forms of payment more valuable in the long run than money. There's nothing like helping a cop fleece his stockbroker wife to get you access to some dreamy databases. And my clients have included not only police officers, but folks in some very interesting bureaucracies. I suspect Lorencz Biggle sends them to me to improve my value for some of their messier divorce cases. Maybe referring Megan was a form of thanks.

One reason she fetched up at my office, rather than half a continent away, was that Darryl began his escape by flying here, twelve days ago. Megan herself had traced him this far, via a contact in Homeland Security, for whom her company had once done "some work." She'd not specified what type of specialty nano Homeland Security might want, and I was just as happy not to know.

Darryl had taken vacation leave and bought a round-trip ticket with a return that would have brought him home last Sunday. He'd checked two bags, boarded the morning nonstop, and (needless to say) not come back. Megan must have been instantly suspicious, because the first day he missed work was when she discovered the missing notes. If he had friends or relatives here, she didn't know of them.

Her Homeland Security agent must have had access to a lot more data than he'd shared, but he hadn't been willing to go very far out on a limb for her. My clients owe me their financial lives, and I'm not averse to reminding them of it.

It helped that Megan either had a key to Darryl's home or had broken in and searched his files. Either way, she'd provided me with a list of his bankcards, etc. She'd even given me his customer loyalty numbers for two grocery chains, a movie theater, and a bookstore. (Don't laugh; I once caught a runaway kid when he cashed in his CineTower viewer points for a free movie and popcorn.)

Except for buying a return ticket he never intended to use, Darryl made no attempt to disguise his airline trip. But once he was on the plane and done with security checks, he'd started covering his tracks. I started by searching

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for a car rental, then for any use of his bankcards or cell phone, but pulled a blank.

That complicated matters, but bankcards and cell phones are fairly easy to avoid using, at least in the short run. Nanos are a different matter. Even if you know they produce electronic traces on the ATM, there are payments that even the most desperate fugitive isn't likely to ignore.

The hard part is getting access to the ATM records. The cops simply ask. Folks like me use worms. Back when Marion and I were on better terms, she knew people who knew people who could create such things. They're a violation of U.S. privacy laws, but that's not an issue offshore, and I can keep my hands clean, at least in theory, by simply asking for a report and pretending I don't know how it's created.

Getting a report on Darryl and setting up an alert cost me $1,000. Hopefully, Megan would reimburse me. For an extra $300 of my own, I asked for a quickie report on Megan herself because she was obviously keeping at least one secret and there might be more.

By 6:30, I was ready to call it a day. You can only do so much computer work in one sitting and remain sane. Darryl's electronic trail, if it existed, would still be there tomorrow.

I'm not proud of what I did next. Marion's job involves long hours, but she's a morning person, not an evening one. It's one of those differences that seem inconsequential until you've been married a few years. Then you realize that neither of you is ever going to change and that trying to arrange your schedules to meet in the middle simply means you're both miserable. Me, I'm still going strong at midnight. Marion has trouble keeping her eyes open after 9:30.

All of which is a convoluted way of saying it was now late enough she should be home from work.

Her new home is in Bill's Landing, one of the most notoriously you-can't-get-there-from-here sections of town. I have no idea what kind of riverboats once docked there, but now it's a regentrifying residential district rising up the bluff behind a narrow floodplain. Every time I have to go there, I find myself too far up the hill, staring at tiers of chimneys and wondering how the hell you're supposed to get down there without levitating.

Marion's apartment occupies the ground floor of one of the most inaccessible Victorian monstrosities in the neighborhood. I reached it eventually and found her car in the street, which has enough parking rules to keep the sign manufacturers in business for the foreseeable future.

So far, nobody's come up with a way to add nanos to parking enforcement, but as I pulled to the curb near a sign reading, "2-hour limit or Zone F Residential Permit 7 A.M.-6 P.M.," it crossed my mind that this was only because nonconsensual nanos were outlawed. If Darryl's truth nano opened the door for others, a parking ticket might someday be accompanied by a nano on your door handle, with the ticket serving double-duty as a warning. *Hi, you owe $40 for overstaying your meter and, by the way, you've been infected with a nano that will make your fingernails drop off if you don't pay within a week.* Oh, joy.

Not that my present plan gave me any right to complain.

Getting Marion to shake hands was the tough part. Even among enemies, the handshake is a strongly engrained custom, but divorce trumps social convention and she left me standing long enough with my hand out that eventually I pulled it back.

"My lawyer said not to talk to you," she said, starting to close the door.

"Wait." Gambling, I reached out and grabbed her wrist. "I just want to understand."

She pulled free, then, discovering the

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moisture and the tingle from whatever it was that carried the nano through your skin, wiped her hand on her jeans. Too late, but dermal contact was an awkward means of delivering the nano. Megan really needed to find a better way, like dissolving it in cologne. Of course, then you'd wind up infecting everyone within breathing distance.

"I'm not here to talk about the property settlement," I said, remembering at the last moment that the nano worked both ways and I had to be scrupulously honest or I'd wind up blushing and sweating myself. Luckily, talking property hadn't been my primary goal and I had a split second to decide I didn't really want to do it at all.

"What else is there to talk about?" she asked.

"I just want to understand what went wrong."

"Oh, Alex, we've been through this a thousand times."

"Yes, but this time I'm prepared to really listen. Was there really nobody else?"

"You've asked that before."

"I know. Just tell me the truth. I promise I'll believe."

She stared at me long enough I was sure she was going to refuse. Then she sighed. "No. Not then, not ever. The problem was that too much of the time there wasn't you, either."

No sweating, no blush. Not at all what I'd hoped for. "What does that mean?"

She sighed again. "How many times are you going to ask that?"

"This is the last, I promise." If you'd asked me, I couldn't have told you whether I meant it, but the seconds ticked by and I wasn't sweating, and presumably not blushing. Nano as self-lie detector. How interesting. Let's put the psychologists out of business along with the lawyers.

"Okay," she said. "But it's nothing new. When I married you, we were both pretty committed to our jobs and didn't have a lot of time for each other. But at least when we were together, you were witty, fun, alive. Then the recession hit and you lost your job. I kept telling you it didn't matter, that you could do anything you wanted: write the great American novel, make good art, make bad art, whatever. But all you did was rant against nanos. Somewhere along the line, that obsession started meaning more to you than I did."

I drew breath to speak, but Marion beat me to it. "Let me finish. This is the point where you always say that this isn't so, that you always loved me, etc., etc. Maybe you thought you did, but you forgot what it meant. You weren't you anymore."

"People change."

"Yeah. But you changed into someone I didn't want to be around. I kept telling you, but you wouldn't listen. At first, you just talked about feeling useless. Then you *became* useless. You wouldn't lift a finger around the house. You'd never been a great lover, but after a while, you didn't even try. Then you started that PI business, which would have been okay, except look at what you wound up doing: mostly it's just helping your old law buddies screw rich people in divorce cases. Well, now you're getting a taste of your own medicine. You deserve whatever my lawyer can do to you.

"Goodbye, Alex. Don't come here again. You don't care about anyone but yourself, and you never will. Maybe you never did."

And with that, she shut the door. There had never been a blush, never a bead of sweat. I didn't know how much of what she said was true, but she definitely believed it.

When I got back to the car, I found a canary yellow envelope stuck under the windshield wiper. The officer had checked a box labeled "Other parking violations, described below," then scribbled, "section 137 (f), Thurs., $53," which wasn't very informative.

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I walked up and down the block until I found a sign reading, "No parking this side, first Thursday each month, street sweeping." Damn this neighborhood. Damn Marion. Damn Megan and her nano. Damn everything.

The next day, I went back to looking for Darryl's electronic trail. If he'd gone to ground in a cheap motel using a prepaid chit as well stocked as Megan's, he was going to be hard to find. But why fly here for that? He had to know how easy it would be to trace his ticket, which meant he didn't care because he was long gone. For most people, that meant a car.

One of my divorce clients manages a firm that archives records for companies wanting off-site backup. Much of that data, nobody could get without a subpoena. But there's a lot I can view with only a modicum of arm-twisting, including most of the airport's security vids.

Picking cameras located near the rental-car desks, I downloaded the feeds, scanned a portrait of Darryl into a face-and-body-recognition program I'd once been rich enough to purchase, and went back to counting bricks. Every now and then, the computer would inform me that it had found nothing useful, and I'd sic it on the next vid. Tedious, but computers don't eliminate tedium; they merely expand its scope.

There were nine rental-car agencies and twenty-four cameras. When they all came up blank, I called it a day and tried to loosen my thoughts with a beer. One became three, but nothing loosened except endless replays of Marion's blush-and-sweat-free accusations, so I forced myself to go home before I was in hangover territory. At least, for the first time in months, I didn't want to sleep away half the next day.

In the morning, I went back to basics. Darryl had landed at gate E4 at 1:29 P.M. His baggage had gone to carousel 7. If he'd bothered to bring it, he must have collected it, and there were plenty of security cams near the baggage carousels. I pulled three feeds, each spanning the hour from 1:30 to 2:30, and set my software to work on them.

Still nothing. To say that I was getting frustrated was a colossal understatement. But I reminded myself how much I needed Marion's money and started viewing the vids by hand.

By lunchtime, I had a big-league headache, but also a likely candidate. He'd not shaved and was wearing a shapeless windbreaker and a baseball cap: three of the world's oldest disguises and ones my software was supposed to be able to see through. But he'd done a good job of keeping the hat pulled low, so that combined with the stubble, the program saw only a seventy-eight percent match, even in image-enhanced freeze-frame. Still, who else could it be?

I watched Mr. Baseball Cap retrieve his luggage—a small duffel and a wheeled suitcase that didn't look big enough for a week, let alone a permanent disappearance. Then I followed him from camera to camera toward the rental-car ghetto.

He didn't immediately go to a clerk, but instead took a seat in the waiting area, watching. After a while, he got in line, pulled something from his pocket, and handed it across the counter. There was a brief conversation, then he retrieved whatever he'd given the clerk and wandered off, eventually taking a new seat. A few minutes later he repeated the process with a different clerk.

Ha! I had him! Hand in the pocket . . . finding an excuse to get the clerk to touch something . . . questions. . . . It had to be Darryl, doing his own bit of nano-interrogation.

On the fourth or fifth clerk, the conversation lasted longer, and when I zoomed in, damned if the clerk didn't appear to be red in the face.

The clerk's flush faded as the conversation proceeded, and I'd have given

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several hours of Megan's money to be able to listen in. Still, I bet I knew the gist of it: Darryl was looking for a dishonest clerk. The lack of an antidote was a problem, but if I were in his shoes, I'd have rehearsed a few times to see just what I could say without triggering the nano. Then I'd imply that I was some kind of auditor and ask the clerks if they ever bent the rules. They'd all say, "Of course not," but the nano would sort them out. If I started sweating myself, I'd just hope the clerk put it down to the weather.

When I found a liar, I'd shift gears and try to convince him that no auditor would ever ask such an obvious question (though once the nano hits the market, they all will). Then I'd see what kind of deal I could strike up. If necessary, I'd switch to extortion and threaten to turn the clerk in for the rule bending I already knew he was doing.

A minute or two later, the vid confirmed my hunch. Apparently the clerk didn't know he was on camera, because the recording caught him accepting a big wad of cash. A few moments later, Darryl walked away with a set of keys.

I noted the time stamp on the vid, then dipped into another database to check for matching transactions. And there was what I was looking for, a rental at exactly the right time to a David Miller.

What is it that draws people to pseudonyms that preserve some imprint of their true names? Is it a Freudian wish to be caught, or merely a desire to hang onto a shred of their real identities? Either way, "D.M." confirmed an identity that my software still questioned.

There was no nano on the rental. No surprise about that. There's no nano on most vid rentals, either. Nanos encourage timeliness. If you're reasonably certain of eventually getting your property back, there's a lot of money to be made on late fees. And I'm sure "D.M." had put down a substantial deposit.

* * *

Once I had the car, the next step was easy. The state has vid cams on a lot of highway overpasses. Officially, they're for studying traffic patterns, but the resolution is good enough to read license plates. I'm sure the police have direct access to the data, but I have to go through another of my grateful clients, who works in a radio station that uses the cams to create "drive time" traffic reports.

Darryl had left town two weeks ago, but one of the axioms of computer life is that nothing is ever erased. For 150 miles he went south at a sedate sixty miles per hour: a man who was either in no hurry or who absolutely didn't want a ticket. I lost him briefly, but then he reappeared forty minutes behind schedule, presumably having stopped for dinner. He continued monotonously south, well into the evening . . . then vanished again a few miles shy of the California border.

I'd been wondering what I'd do if he continued all the way to California. Presumably, the Golden State also had freeway cams, but the radio station didn't link to them, and while I have access to a couple of pretty esoteric databases, I was going to have to pull some major favors to tap into the California system.

As it turned out, this was as far as he went. I set up a macro to fast-scan license plates at the next cam to the south, but he didn't reappear that night, nor the next morning—nor, or for that matter, anytime until the present. Just to be thorough, I checked both directions, but there was no sign of him coming back this way, either. He'd left the freeway at the tiny town of Franklinville, more or less in the middle of nowhere, and apparently stayed there.

As a hiding place, it stank. It was the start of tourist season, so for a while, he could blend in as a vacationer, but Franklinville lay in a horseshoe valley surrounded by mountains, with no way out except the freeway. Darryl had rented his car for a full month, so it wasn't

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due back yet, but when he failed to return it, I wouldn't be the only one looking for him, and even though he was obviously ignorant of the freeway cams, he had to know he couldn't drive around forever in a stolen car.

The next morning, I called Megan to see if she knew why Darryl would hole up in such an odd place. She didn't and was all for dashing straight to Franklinville to check it out.

It took some effort, but I talked her out of it. Darryl's self-imposed trap was a lot smaller than the West Coast as a whole, but he still had a lot of room to hide and I didn't want to scare him underground by floundering around at random. Especially not before I had at least a basic understanding of why, of all places, he'd picked it.

"And how do you think you're going to do that?" Megan asked.

That was simple. I needed to know more about Darryl: the person, that is, not the shadowy figure in the baseball cap who'd nearly eluded the airport vids. I needed to understand the man who created a truth nano, then stole the key to a fortune. "Tell me about him," I said.

"Well, he's brilliant. Straight A's at Harvard. Then dual PhDs, one in biochem and the other in computer science. After that—"

I shut off the stream of useless data. "Not his resume. What makes him tick?"

There was a long pause. "Well, he works really hard."

"That's obvious." What is it about these career-driven folks that keeps them from truly seeing even the people closest to them? "What about when he's not working?"

There was another pause, and while I was still convinced they'd slept together, I began to wonder: did she really know him other than in the biblical sense? Abruptly, I realized it wasn't just techies: it was anyone who melted so deeply into their careers. Like me, according to Marion. Maybe like her, too? Had we, a lawyer and a computer tech, simply been a pair of Megans?

As the comparison formed, I wondered how much of Marion's anger might be self-directed. Before the nanos, making partner at a large law firm, even in the supposedly laid-back Pacific Northwest, was an exercise not just in working midnights and Sunday mornings, but being *seen* doing so. It took years, and by the time you could relax, you'd forgotten not only how, but why. Marion's job had been much the same.

Perhaps, when it all fell apart, she had realized what I had not: that the nano-depression had given me a way out. But instead of jumping at the chance, I'd hared off after a new all-consuming career, even when it hadn't given me much to do but count bricks and grumble. Deep inside, where even the nano wouldn't find it, had she realized that she too was trapped by her own ambition?

None of this had anything to do with finding Darryl. I heard Megan draw breath, and for a moment, feared I'd missed something. But apparently not.

"I'm not sure I know what you're looking for," she said, and I suspected that if she were under the nano, she'd be right on the edge of blushing, because the real answer was probably simpler: *I don't really know him*. But that didn't mean there wasn't a good, practical solution. "Why don't you come down here and take a look at his apartment?" There was another long pause. "That might be more useful than talking to me."

Megan's invitation came with two revelations, one big, one small. The big one was that hotshot researcher Darryl had an apartment, not a condo: strong confirmation that he too had no life. The small one was that "here" was New Orleans. That explained the French pronunciation of his last name.

Megan, not one to waste time once a

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decision had been made, booked me on the next flight while I packed. That evening, she met me at the New Orleans airport and hustled me to Darryl's French Quarter apartment.

I'd never been to New Orleans before, and the first thing I noticed was that even though it was after 11 P.M. on a Sunday night, the downtown was very much alive. The second was that Bourbon Street reeked of beer and vomit.

"We're in a drought;" Megan said. "It's not so bad after a rain." Which was probably the case, but party-till-you-puke is just another form of not having a life. Between alcoholism and workaholism, I'll go with work. If nothing else, it's better for your liver.

Darryl's building was on a side street, just far enough from the main action to almost qualify as quiet. Megan let me in, then snapped on the lights with the ease of someone who knows exactly where to find the switch. But however many times she'd been here, the apartment showed no sign of feminine occupancy. The living room was a manly haven of wraparound video and infinite-channel sound—so state-of-the-art that I could barely recognize the components. Beyond it gleamed a steel-and-polish kitchen suitable for a master chef.

I'd never seen such a kitchen except in movies, and I wandered in, amazed. "I take it he cooks."

Megan shrugged. "Usually he eats out. But when he does cook, he likes to do it right." She paused. "I guess that's the type of thing you're looking for, isn't it? Darryl won't do anything unless he thinks he can do it right. Otherwise he doesn't bother."

Her voice had an odd tone, and I wondered whether I might just have gotten an insight into something else about their relationship. Maybe their sex life? Or mine and Marion's? *Don't go there*, I told myself, and surprisingly, I didn't.

Back in the living room, I examined the vid-and-sound system. There were no racks of chips, which meant everything was on an optical stack in one of those stylishly melted-looking boxes whose functions I could barely guess. Luckily, Darryl wasn't a control freak (another interesting piece of information) and he'd let Megan use his toys whenever she wanted.

I asked her to show me the index to the drive, because, if books are windows to the mind, music is a window to the soul. Darryl's collection was enormous—nearly 100,000 titles of such diversity I suspected he'd bought the whole thing intact: an instant music library for the man with a soul, but no time for life. Or maybe a man in search of a soul.

"When did he get this?" I asked.

Megan hesitated. "Shortly after his mother died," she eventually said, and I perked up at yet another tidbit of information. "About a year ago."

"Did he take her death hard?"

"It had been coming for a long time," she said, which she thought was an answer, but wasn't. Marion and I had been sick for a long time, too.

With a lot of experimental button poking, I pulled up the machine's play log, which showed a recent taste for opera. High drama, high emotion. Not surprising for a man about to abandon his entire life for . . . what? That, of course, was the question, and the answer wouldn't be in Wagner. Time to check a few of those windows to the mind.

Darryl's living room had only one bookcase, but there could be a lot more than that on his bookreader. Like the stereo, it was state-of-the-art, but this time, the contents were limited. A few mysteries and thrillers—the type of thing everyone reads on sleepless nights. More interesting were the print books: three full shelves, and not a nanotech tome in sight. Darryl probably had plenty of professional books in his office, but what dominated here were adventures. Mountaineering, Antarctic

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treks, deep-sea exploration—you name it. All beautifully cared for but also obviously read.

Megan was looking over my shoulder, but I didn't want to break my chain of thought by speaking. Darryl had a stack of adventure books. He'd gone to ground in a small town on the edge of the wilderness. He didn't do anything he didn't think he could do well. And based on the sound system, he had a penchant for taking up new activities . . . full-blown. Darryl, I suspected, was no longer in the snug confines of Franklinville.

There were only three other rooms, a den, a bedroom, and a bathroom. The bedroom and bath were unremarkable; the den had a computer, more books (this time including some professional texts), and stacks and stacks of magazines.

I have a friend who's a voracious reader but never touches books because she's a single mother and doesn't want to start anything she might have trouble finishing. She would have loved Darryl. More interesting, though, was his taste in magazines: *Backpacker*, *Canoe and Kayak*, *National Geographic Adventure*, *Field & Stream*, *Couloir*. There were outdoor magazines on at least a dozen other topics, but none dated back more than a year. When his mother died, Darryl had started looking for his soul. To all appearances, he hoped to find it in the backcountry.

Along with the magazines was a bundle of mail, wrapped in a rubber band.

"They were holding that at the post office," Megan said.

"And you just waltzed in and got it?"

"More or less." She tossed her head and flashed a high-voltage smile. "I thought you might be interested."

She'd guessed right on that. I was already pulling off the rubber band and flipping through junk mail. Most was useless, but halfway through, I struck gold. Literally. It was a subscription-renewal notice from *Goldbug* magazine, which styled itself as "The World's Leading Gold-Panning Journal," implying it had a lot of rivals. Dubious advertising claims aside, what caught my attention wasn't that Darryl had an interest in panning; it was that I'd not seen a single issue of *Goldbug* in his den.

I may not have much of a life, but I love trivia, and one piece of trivia I long ago collected was that the California Gold Rush extended slightly north of the border. I also knew that the gold was by no means exhausted: new deposits show up each spring. Five minutes ago, I couldn't have said whether Franklinville was in Gold Rush territory. Now, I was sure it was, and I knew why there were no copies of *Goldbug* in Darryl's apartment.

Darryl had taken them with him.

I slept on Darryl's couch while Megan used his bed. Before turning in, I'd suggested that we make a morning visit to his office, but she'd nixed the idea. "There's nothing there," she said. "I've checked."

Given how much she'd missed in the apartment, I wasn't sure, but before I could find a polite way of saying so, she was yawning.

"I'm beat," she said, "but I presume that *now* you're ready to go to Franklinville?"

"Yeah."

"That's going to take a few days, so obviously you're going to be working for a second week." She pulled her credit chit from her purse. "You've also incurred some expenses. Let's take care of those and next week's fee, before I forget."

It was a patent attempt to distract me, but when it comes to that kind of cash, I'm easily distracted. There probably wasn't anything worth learning at the office, anyway.

When I woke up, Mardi Gras was in full force on the street outside. No, that wasn't right. It was in the room with

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me, shaking me, hard, and calling my name.

"Damn, you sleep soundly," Megan said, as I squinted at my watch. The first digit was 4.

"Urrrh?" As brilliant repartee goes, it wasn't much, but she got the idea.

"Your computer's beeping. It says 'urgent.'"

Actually, it was long past beeping. As she spoke, it shifted from something that sounded like an airhorn with an anger-management problem to a boisterous rendition of the "William Tell Overture." I'd obviously spent too much time sleeping in, of late, because even jetlagged, the milder tones that must have preceded these should have been enough to get my attention.

I'd left the computer logged on, in case something came through on one of several automated alerts. Earlier, in fact, it had informed me that the nano-payment reports on Darryl and Megan had finally arrived, but there'd been no privacy in which to read them.

This alert had to be something major. Briefly, I hoped Darryl had used one of his credit cards, but instead it was the car, which had tripped a freeway cam. As my still-sluggish neurons processed this information, the car tripped a second cam, heading north.

"What the. . . ?"

Megan put it more succinctly. "Crap. He's heading back to the airport."

I saw the rest of my big fee disappearing. "Do you think he's coming home?"

Megan's voice was ice. "He took his lab book. Nobody does that and expects to come home. Wherever he's going, it isn't here."

From Franklinville back to the airport is a six-hour drive, and there's no such thing as a five-hour flight from New Orleans. Still, there was nothing for it but to try. With the search heading into a new phase, somehow it was just presumed that Megan would be going with me.

Seven-and-a-half hours later, she and I were pushing our way off the plane and sprinting through the concourse. Enduring a tirade from a cabbie incensed at such a small fare, we passed up the too-slow rental car shuttles . . . and found that miracles really can happen. During the flight, I'd not been able to boot up the computer to check Darryl's progress, but in the cab I got a wireless connection and discovered that his car had stopped for a couple of hours in a rest stop. Hurrah for naps.

With a big tip to the still-cursing cabbie, we beat the car to the rental lot and found a waiting place where Darryl would be across the "severe tire damage" strip before he could see us.

It proved an unnecessary precaution because Darryl wasn't in the car. Instead, the driver and sole passenger was a teenage girl who was thoroughly frightened when we intercepted her. She was so spooked that Megan couldn't get close enough to infect her with the nano, but her story rang true, so it hardly mattered.

No, the car wasn't hers. Some man had paid her to return it but told her there was no hurry. Was that against the law? Were we cops?

Yes, she could describe him. His name was David something-or-other. The full name was on the rental form.

When had he given her the car?—let's see, it was two days before her best friend's birthday, so it must have been last Thursday, which was what, a week-and-a-half ago? Something like that. He'd gotten talking to her at the restaurant where she waited tables, then given her the keys a day or two later.

Afterward? He'd just walked away. He'd not asked her to give him a ride anywhere, and the deal would have been off if he had. He'd seemed nice, but there was no way she was getting in a car with him.

How had he known *she* could be trusted? She had no idea, but she'd always been honest. When she was pick-

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ing up his dinner plate, he'd looked her in the eye, asked her point-blank if she was dependable, and somehow known she was. And he was right, wasn't he?

I left her to the tender mercies of the rental-car company, which undoubtedly gave her a rude education about unauthorized drivers. It should have been happy just to get its car back. Until the alert went off this morning, I'd have given long odds it was at the bottom of a lake.

I thought again about Darryl and his quest for a soul. Whatever his game was, the only thing he'd been willing to steal was the lab book. I wouldn't be so honest. Now, Megan and I knew exactly when he'd hit the backcountry, and unless he had another means of transportation, he must have started on foot, from the center of town.

As it turned out, he did have another means of transport: oar-powered. Franklinville is on the Kalmiopsis River, and unlike the roads, the river goes right through the mountains. Darryl had bought a drift boat—a flat-bottom craft capable of going only one direction: downstream. En route, he would have passed a multitude of creeks where skill with a suction pump and sluice box would allow you to earn a grubstake if you weren't too picky about the grub.

But before leaving for Franklinville and this discovery, I begged a few hours' leave from Megan and used part of it to read the nanopayment reports on her and Darryl.

Megan's was unexceptional except for the size of her mortgage. She might not have been comfortable in her executive-on-the-make attire, but if she could afford payments like that, she was a lot more than a mere lab assistant. For an extra $3,000, my worm-programmer offered to trace her credit-card statements, but I wasn't going to authorize that.

Darryl had been financially even better off, with the emphasis on *had been*. In a series of transactions beginning three months ago, he'd pulled money out of his retirement account to pay off his nanos, one by one. With the tax penalties, that had pretty much wiped out his savings. Then he'd finished the process by withdrawing his remaining cash. Except for the IRS, whose computers nobody could hack, Darryl was now off the nano grid. But he was also pretty close to broke, and unless he intended to eat moss and live in hollow logs, he wasn't going to last long without finding some of that gold.

But the most intriguing report was one I hadn't requested. Perhaps in hopes of inspiring me to spend the extra $3,000, my online friend had done an unasked favor and run a quick check on Megan and Darryl's employer. It turned out that Southern NanoSystems, Inc., was an extremely small outfit indeed—small enough that if its product were law rather than technology, it would be called something like Graham Darryl & Megan, LLC. Or more precisely, Marnier Marnier & Fordham, because Darryl and Graham were brothers. Graham was CEO and head marketing guru; Darryl and Megan paired up on research.

Presumably, there were other employees, but the important thing was that Megan was a principal—a junior partner by the look of it, but still a partner. That meant she had enough money that it was possible that I had been hired not by SNS, but solely by her. She also had her own Ph.D. in combinatorial biochemistry, a field I'd never heard of before, but which sounded impressive.

Reluctantly, I set aside the report and packed for an extended trip. My aging car wasn't up to the job (if it had been, I'd have sold it, weeks ago, to pay my rent), so Megan and I had rented something newer and I'd promised to pick her up soon. In the mean time, as I loaded the trunk, I speculated about love triangles.

Maybe Megan had dumped Darryl for

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Graham, and Darryl had stolen the research notes as a way of striking back. Maybe she was afraid of what would happen when Graham found out the notes were gone. That would explain why she'd kept me away from the office and any chance of bumping into him. As theories go, it was as good as any.

In Franklinville, I was sure we'd pick up Darryl's track if we played it smart. That's because I know small towns; I grew up in one, east of the Cascades. Mine had been a cow town, but some things are universal.

Small-town people love to gossip about strangers, but are slow to gossip *with* them. The solution is not to be pushy. Years ago on a hiking vacation, after several days of buying lunch supplies at the only general store in the vicinity, I'd had the proprietor warn me, with no trace of irony, to be careful of strangers because there'd been a murder in the vicinity, and the killer must have been from out of town.

At first, everyone in Franklinville was suspicious as hell because the story of how Megan and I intercepted Darryl's car had beaten us to town. But they were also curious, and that could work to our advantage. The hard part was persuading Megan that it was more important to be nonthreatening than to immediately start asking questions. Once she got the idea, she found just the right mix of sexiness and girl-next-door charm, and even managed to produce a disarming Southern accent. In public, we exchanged glances and touches and generally gave the impression that chasing Darryl wasn't the thing we really wanted to be doing. Not exactly the most difficult of duties.

When asked, I told folks I was "David's" cousin and that his sister had been diagnosed with cancer. David, I said, was writing a book about living off the land, but hadn't thought to tell his family precisely what land he intended to live off of. We were afraid that by the time he got back, it would be too late.

It was one of those stories with just enough truth to fit what people had seen of him, and soon enough, they were volunteering information.

There was no reason for people to lie to us, but Megan insisted on verifying everything under the nano. Because we were ourselves living a lie, that created logistical difficulties which we solved by doing what I thought of as a form of the old good-cop/bad-cop routine, but which Megan compared to a lab technique known as "clean-hands/dirty-hands." I would start each interview by introducing myself and shaking hands. Then Megan would follow suit, using the nano. That left her with little to do but look pretty and keep quiet while I spun the dying-sister tale. The only time it failed was when some chivalrous soul insisted on shaking Megan's hand *first*, therefore infecting all three of us with the nano and pretty much nixing that interview, plus the rest of the afternoon.

Soon enough, we found the woman who'd sold Darryl his gold-mining equipment, plus the clerk who'd equipped him for the wilderness. But I wasted quite a bit of time trying to find someone who might have sold him a packhorse or a llama before I stumbled, more or less by accident, on the man who'd sold him the boat. What can I say? I'm not a river person, and even though our hotel was right next to the water, it had never crossed my mind that there was a way out of here that wasn't on foot.

Three days later, Megan and I were floating downriver in a pair of inflatable kayaks. Since we were carrying ten days' food, I'd gotten her to advance me an equal number of days' pay, then paid up all of my nanos, even those that weren't all that close to due. Running low on food was one thing, but with downstream rapids boasting names like Widowmaker, Leap of Faith, Submarine

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Hole, and Mixmaster, I didn't want to be worrying about getting to an ATM if we were delayed.

A local outfitter had talked us out of buying a drift boat similar to Darryl's. "If you know what you're doing, you can get one of those over Leap of Faith," he said, "but if you don't line it up perfectly, it's not coming out the other side. You sure you don't want a guide? If not, I recommend something small and easy to portage."

Darryl had the better part of a three-week head start, but the mining-supply clerk didn't think he'd be hard to find. "There's plenty of color in some of those gravels," she said, "and he's got a metal detector good enough to find nuggets down to this size"—she held her fingers a tiny pinch apart. "Once he gets the hang of it, he'll find a good spot and stay there until he runs low on food."

It helped that Darryl's boat was too big to hide. So long as we kept our eyes open, we couldn't miss it.

It's not always that easy, though, to keep your eyes open in an inflatable kayak. Too often, you're either concentrating on paddling, or floating backward with a great view of where you've been, but a crappy one of what lies ahead.

An inflatable kayak isn't really a kayak. It's a mini-raft that you paddle with a kayak paddle. And while it's nice and zippy, it tends to zigzag all over the place until you give up and try to relax. Then it immediately spins into that tail-first orientation, which makes it hard not only to get advance notice of beached drift boats, but, more importantly, of rocks.

The outfitter had insisted that we buy wetsuits, and within minutes, I was glad we'd complied. Not only was the water surprisingly cold, but Megan looked unbelievably cute with nothing but a layer of form-fitting neoprene between her and the world. In theory she should have been wearing a life jacket, but I wasn't going to be the one to remind her until we hit serious whitewater.

For the first few miles; the river was swift but calm, and, other than trying not to stare at Megan, my primary goal was figuring out how to make my boat go where I wanted. We'd bought top-of-the-line models, which the outfitter had described as "self-bailers," but it wasn't until we actually pumped them up that I understood how they worked. Paddling, I sat on an inflated mat, like an oversized air mattress. Below that was the true floor, which was full of holes an inch or so in diameter. The first time I hit a sizeable wave, I got a big load of water in my lap, but within seconds, it had all run out the bailing holes as the air-mattress floor lifted everything back to the surface. Impressive, and nearly as much fun as watching Megan in her wetsuit.

Sometime after lunch the canyon narrowed and a throaty roar announced the first rapids big enough to have a name. My map was tucked away in a waterproof bag, but I remembered what it was called: Upper Kicking Horse, rated class 3.

A kayaking primer I'd speed-read in Franklinville had told me that rapids are rated on a six-point scale according to danger. Class 6 means experts beware; class 1 means suitable for kiddies. Class 3 is in the middle but mild enough that injuries are rare. Big deal, I figured, and rounded the bend.

I was greeted by a bank-to-bank wall of foam. A recent landslide had pinched the river into a green "V" leading to a chute that dropped three or four feet to a chain of whitecaps. Just the type of thing the tourist rafts love in places a bit closer to civilization. Remembering my speed-read guidance, I aimed for the heart of the V, murmured a barely remembered prayer, and slid over the lip.

The good news was that I made the drop just fine. The bad news was that

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whitecaps were even bigger than they looked. Panicked, I tried to dodge them but didn't make it and hit the first one at an angle. Bad mistake: the boat flipped so quickly I don't actually remember it happening. One moment I was thinking "oh-oh" and the next I was in the water.

Fortunately, I have quick reflexes. Clutching the paddle with one hand, I grabbed the boat with the other and let the current pogo me through the remaining whitecaps into calmer water downstream.

Now what? The inverted boat would take forever to tow ashore. Furthermore, my mind had belatedly produced the thought that if there was an Upper Kicking Horse Rapids, there was probably a lower one. In fact, I thought I could hear it, though that might just be my imagination.

What I needed was to get back in the boat, and the first step had to be un-flipping it. The how-to book hadn't bothered to say how to do this, but there were those convenient bailing holes—the only features on the boat's otherwise-smooth bottom.

Still gripping the paddle, I hooked my fingers in the holes and dragged myself partly out of the water. Then, I reached across to the farthest holes, dug a knee into the nearside of the boat, leaned backward, and *plop*—it came over on top of me. I got dunked again, but the boat was now upright, and I was still holding its gunwale. An explosion of apples bobbed in the water from a bag I'd failed to close securely enough, but everything else appeared to have been well tied down.

I still had to get back in the boat, and now I was sure I could hear the lower rapids. I tried slithering over the gunwale, but it dipped alarmingly, and I barely managed to slide back into the water without flipping the boat back onto my head. The downstream roar was louder than ever.

I was running out of time. Unlike Megan, I was wearing a life jacket, but my imagination was producing rapid-fire images of cracked kneecaps, bashed skulls, dislocated shoulders, and other injuries which would be as bad as drowning, and probably more painful.

Adrenaline is marvelous stuff. It not only gives you strength, it slows time so you can think through important details, like how not to die. Or maybe there's no true, conscious thought involved, merely chemically directed action that has the same effect. However it works, I realized that the paddle was the key. I placed it crossways, so I could distribute my weight across both gunwales. Then, kicking vigorously enough it's amazing I didn't pull a muscle, I swarmed across the nearside gunwale with all the grace of a beached walrus. I flipped my feet around in front of me, got my butt firmly into the seat, and looked forward to find the source of the roar.

What I saw was a maze of rocks and ledges stretching nearly to the next bend. I had about one second to think that I should pull to shore to scout the best route, followed by another half-second in which I realized it was too late. Then the foam ate my apples, one by one. I just barely had time to decide that the current had probably taken them along as good a route as any, then I followed suit. I steered to the right of an enormous rock, accelerated, and it was too late for second thoughts.

As I passed the rock, things began to happen very quickly, but somehow the same adrenaline-induced clarity that had led me to figure out how to get back in the boat now left me thinking like the river, rather than trying to fight it. A secondary rock materialized ahead of me, and I danced my tiny craft sideways just far enough to miss it—like a golf ball rimming the cup on a narrowly missed putt. Another reflex dodge scooted me off line from an impressive hole, but that sent me toward a two-foot pour-over across a wide ledge. Having learned the hard way that it was better

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to meet obstacles head-on than be caught in the middle of an unsuccessful attempt to dodge, I pointed for the ledge, took three or four sharp strokes to provide headway for steering, and hoped the water was deep enough not to bruise my tailbone. Then I was in the turbulence below, whooping like a teenager.

I found a gravel beach and pulled to shore, still giddy with adrenaline. From there, I could see Megan, dragging her boat around the first rapids, so, making sure my own boat was well beached, I trudged upstream to help. I suppose I could have offered to paddle her boat through, but I didn't want to stretch my luck, so I simply assisted with the portage. It was tough going, and when we got around the lower rapids, we'd done enough for one day.

By the time we found Darryl's boat, we were rating portages on a scale like that used for rapids. Leap of Faith Rapids was a class 5—a twisty series of chutes spilling into a fissure of bubbling water—but the portage scored a solid 4, with poison oak at every flat spot and a constant threat of rattlesnakes. The portages around Submarine Hole and Mixmaster were even worse, and there were others where, if it weren't for the threat of losing our boats and equipment, we would rather have taken our chances with the river.

All the way, I half-expected to see Darryl's boat wrecked on a rock, but apparently Megan was right: he really didn't do anything unless he was sure he'd be good at it.

The boat was winched ashore with a line looped around a big pine. Darryl was nowhere to be seen, but a well-beaten path indicated frequent trips up a side creek, and a fishing pole and tackle box on the beach suggested he might soon be back.

The boat's storage lockers were crammed with equipment: another indication that Darryl made frequent return visits. I rifled quickly through, but all I saw were food, stove fuel, a life jacket, clothing, and camping supplies. Nothing that *looked* like a lab book, though for all I knew, I was looking for a bookreader chip hiding in a bag of granola. I'd never asked Megan what form the notes might take, because until now it hadn't mattered. It probably still didn't, because if I were Darryl, I wouldn't leave them here, unattended.

All the way downriver, I'd been playing out scenarios in which sometimes we found Darryl with the boat, and sometimes we didn't. Megan must have been doing the same. "Let's paddle back upriver a bit and hide our boats," she said. "Then we can find a spot to wait for him to come back."

I'd been thinking along the same lines. Luck had dealt us the advantage of surprise, and there was no need to squander it by strolling up Darryl's trail in broad daylight. If we had to look for him that way, I'd rather go at dawn.

The current was gentle enough to make upriver paddling feasible, and the walking was a lot easier than most of our portages. Unfortunately, we were in full sun, on a west-facing slope.

"Damn, it's hot," Megan said, halfway back to Darryl's boat. We were still wearing our wetsuits—normally not a problem with all of that cold water nearby. But if our goal was to keep out of sight, splashing in the river wasn't the way to do it. Luckily, she'd thought to bring a fanny pack: one of those runner-things that also holds water bottles. She passed me a bottle and a granola bar, and we settled down to wait.

The water was nearly gone by the time Darryl arrived. One moment I was wondering if the Sun would ever drop below the canyon wall; the next, he stepped into sight so unexpectedly he might almost have teleported from outer space. He walked directly to his boat, bent over the bow compartment, and began rummaging.

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He looked surprisingly like his photograph. Surprisingly, that is, because he'd had time to turn the stubble into a beard, shave his head, gain or lose weight, or do any of the things *I* would do if I were in hiding. He wasn't even dressed all that oddly, though he probably didn't usually wear hiking boots to work and his pants showed stains. Maybe he figured there was no reason for disguise because anyone who managed to track him this far would see right through it, but the impression was of a person who was comfortable with his appearance and didn't want to change. I again thought about his yearlong search for a soul. Whatever Darryl had been running from, it didn't appear to have been himself.

It was Megan who first rose to intercept him. She caught me off guard because on the river I had half-forgotten that I was nothing more than a well-paid employee. Relegated to a supporting role, I circled to the side, moving to cut off Darryl's retreat should he make a dash for his camp or the rugged country beyond.

Megan was halfway to him before he looked up.

"Hi, Darryl," she said.

He straightened, his expression unreadable. "Megan."

"You left me," she said, and I wondered which was more important: that, or the nano. Probably both. Marion and I could never stay focused on any single issue, so why should Megan and Darryl? The one thing I was sure of was that my speculations about love triangles were wrong. Megan was obviously the dumpee, not the dumper.

"We no longer wanted the same things," he said in another echo of things I'd heard too many times before. "I gave up trying to explain. There had to be a better way to live."

Megan's eyes swept the beach and Darryl's grubby clothes. "What, this?" She was trying for contempt, but there were a lot of other things mixed in.

Darryl chose to ignore them all. "You know what I mean. There are just too many nasty uses for that thing. We should have thought them through before we started."

"So you just decided to stop the project on your own? We'd sunk too much into it. We couldn't afford to just quit."

"Yes, we could. Graham must have told you so. The company will survive."

"Who wants just to survive? We were on the verge of being rich, and you decided to piss it away for *this*?" Again her gaze swept the canyon. Cliffs leaping to a cerulean sky. Water gurgling against grass-and-pine riverbanks. Muscles hardening into contours not seen since youth. Nobody else around. Some people wait years for a vacation like this, and Darryl had found a way to make it a lifestyle.

Megan wasn't in a mood to see any of that. "What happened to you?"

"People change."

"Not that much."

Darryl's lips were tight. "Maybe I didn't change. Maybe I finally found out who I really was."

Megan started to retort, then bit it off. She reached into the fanny pack that had held the granola bars, and suddenly she had a gun: a tiny, snub-nosed .22. It didn't look very accurate, but from ten feet away, how could she miss?

I hadn't signed on for this. Maybe I tensed, or maybe she read my mind, because the gun shifted until it was pointed squarely at my chest, though she continued talking to Darryl.

"I want the notes," she said.

"What makes you think they still exist?"

"Because you took the chips with you rather than just erasing them as you did with the backups. And because you like to keep your options open, in case there's a time when you need a change of plan."

The gun shifted. "Like now," she said, and there was a pop. Even before the first blood appeared on Darryl's shirt,

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she'd taken two steps backward and lined the gun back up on me. "Don't even think of it," she said.

Darryl was still standing, gaping at the blood. "Ow," he said, which seemed a bit of an understatement from someone who'd just been shot.

Megan had retreated far enough that she'd have time to get off more than one shot if I tried to rush her. Not that I had any plan of doing so. A .22 may not pack a lot of punch, but the bullets can penetrate. As a kid, I once tried target shooting with an abandoned barn as a backstop. When I was done, there was a nice pattern of holes in the boards on the near side of the barn—and a matching pattern on the far side. I'd have to be pretty desperate to risk letting Megan do to my chest what I'd done to the barn.

Oddly, Darryl didn't seem badly hurt, and the blood was oozing from several holes in his shirt, all too small even for a .22 bullet.

It took a moment for my brain to catch up with my eyes. "Birdshot?" I asked. I'd heard of such things: a handful of tiny pellets in a .22 cartridge. In theory you could bring down a grouse if you got close enough. In practice, it had to be a damn hard way to hunt.

"More like rock salt," Megan said.

Darryl paled. Then my brain clicked again, to the reality the two of them shared. "Nanos," I said. And I'd thought Megan needed a more efficient delivery vehicle. Gads. Nothing like just shooting them into someone's chest.

"Yes." The gun was still on me. "Believe me, this isn't a nano you want."

"What exactly does it do?"

"Three guesses." The playful belle was gone, along with every other persona I'd seen her wear. What I saw now was colder, more calculating. Too emotionless not to be another façade, but an effective one.

"The truth nano."

"Give the man a kewpie doll. But"—she was now talking to Darryl, who still hadn't spoken—"with a new effectuator. This one's a bit nastier." Her eyes looked like Marion's when she'd told me what she hoped her lawyer would do to me. "Lie to me now, and you die."

Darryl finally found his voice. Not necessarily a good thing, since silence seemed his best survival tactic. "The asthma nano."

"Nah. A heart arrhythmia's easier to make fatal. And this one won't wear off in a few hours. So now, we both have an interest in the antidote. I hope those notes still exist."

"It doesn't matter," Darryl said. "This is exactly the type of thing I had in mind when I decided we had to cancel the project."

He had not said that the notes didn't exist, and Megan was too smart not to have picked up on it. If Darryl hadn't destroyed them, my bet was that they were somewhere nearby, and if they were, it didn't matter what he said now, because she would find them eventually. Even if they were buried, there'd be enough metal in the chips' plug-in cartridges that the damn things would probably show up on Darryl's gold-nugget detector.

Darryl must also have realized he'd said too much, because suddenly he rushed her. *Pop* went the gun. *Pop*, *pop*, and I realized that he didn't have much to lose from being shot again. But there's something so intimidating about a gun that it took me until the third shot to figure it out.

I, of course, had a lot to lose, so I stood my ground until he reached her, grabbed her hand, and wrenched at the gun. It went off again, with a slightly different sound, but maybe that was because it had swung my direction and something whizzed by me, too close for comfort. Then Darryl had it and Megan was staggering back.

"Your turn," he said, and shot her point-blank.

I'd like to believe it happened faster than I could react, because at the mo-

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ment I certainly shared his attitude. *Give her a taste of her own medicine. See how long she can go without telling a lie.* It was a frightening mix of Marion's farewell words to me and the way I'd been thinking when I'd infected her with the original nano. The stakes were higher, but the motivations identical.

Megan didn't simply say "ow." Instead, she stutter-stepped backward, her mouth working soundlessly. Another step and she was swaying, and there was blood on her wetsuit. Too much blood. Lots of blood.

I've watched people die before, but always in hospitals, with the patient comatose and the final event announced by the nothing-there tone of a cardiac monitor on flatline. This was different. I don't know what artery Darryl managed to hit, but it was a big one and it didn't take a fancy monitor to count the heartbeats pumping the life from her body.

I now know that there really is a light in the eyes that goes out at death, at least death by trauma. I have no idea whether it coincides with the precise point of death, but Megan's eyes were alive when I lowered her to the ground and leaned on the wound with all of my weight, in a useless attempt to stem the blood. They weren't alight when the flow slowed on its own and I shifted to CPR. Still, I worked on her for a long time.

I worked to assuage my own guilt. I worked because I didn't know whether she was an evil person, a greedy person, a driven person, or merely another person lost in a world too subject to change—whether it's divorce, a career that vanishes, or a lover who wants to do the right thing before you're ready. I worked because people change and her chance had been cut short. I worked because my own change was past due. I worked long enough to become more than just emotionally drained: long enough that my arms ached and my own breath came in wheezing gasps.

When I finally gave up, Darryl was still holding the gun, trying to figure out what had happened. But I knew. There's an old bear-protection trick used in grizzly country: you take a 12-gauge shotgun and load it with slugs, followed by a couple of rounds of buckshot. The idea is that if the bear keeps charging after being hit by the slugs, the buckshot might blind it. Megan had used a similar trick in reverse, loading her gun with nano pellets followed by real bullets. But she'd used too many pellets and forgotten to warn us about the bullets.

If she'd been able to pull the trigger just a little faster, it might have been Darryl on whom I wound up doing CPR. But I want to believe that murder had never been her intent. Most people underestimate the deadliness of a .22, and I need to believe that she was one of them. *Hurt*, not ***kill***. That's the norm when love goes away.

Darryl didn't even know my name, or why I'd been with Megan, though he could probably guess the latter. Still, when I reached for the gun, he surrendered it. And when I threw it in the river, he nodded. As introductions go, it wasn't bad. Then neither of us spoke for a long time.

"I loved her," he said at last.

He needed to talk, but it wasn't wise. "Darryl . . ."

"I really did. I always thought that someday she'd understand."

"*Darryl.*"

"Did she tell you her father was an accountant? His money was part of what got us started at SNS. But he kept having to tell one of his main clients, a big law firm, to fire people who'd been with them for years. He was a good man and it depressed him. Last year, he committed suicide."

"About the time your mother died?" The question was out before I could stop it.

Darryl had been staring at Megan's

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body, but now I had his full attention. "Has something happened to my mother?"

Oh, Megan, I thought. Lies and half-truths and onion layers on onion layers. It had been *her* parent's death that had set Darryl to reexamining his life, but she'd not been ready to admit it, probably not even to herself.

"Your mother's fine," I said. "I misunderstood something."

I could see him start to ask, then change his mind. "Anyway, that made me reexamine what the hell we were doing," he said. "But Megan acted as though nothing had changed." He looked back at her body. "Maybe for her, it hadn't."

I wasn't so sure. Perhaps Darryl was right and it was all just money to her, but maybe she had fixated on the truth nano as though, in all its ramifications, it might hold the key to her own tumult. The death of her father explained a lot about why she'd picked me, of all PIs, and why she'd been so generous with her money.

But now wasn't the time to debate it. "Darryl, remember the nano."

"But it's true. I—"

"*Shut up*. You're feeling guilty and confused, and the nano might not know the difference."

"Well, one thing I'm sure of is that I'm not making the antidote. Letting that get out is a risk I won't take."

I had no idea how big a risk it actually was, but he didn't clutch his chest and drop dead, so it didn't matter: it was too much for him, and that was that.

There were, of course, myriad practical matters. First, Darryl had to learn that being a basically honest person wasn't enough. Even on the most mundane subjects, he had to make sure he thought very carefully before speaking. I suggested he write everything out in advance. That way, he could play with the wording to his heart's content without doing anything the nano might see as lying.

Then we had to decide what to do with Megan's body. There really was only one choice, so we buried her among the trees. If we called in the authorities, Darryl would either die under questioning or be forced to reveal the nano, and then everything would have been in vain. Afterward, he stood by the river: quiet, pensive. Then with a sidearm gesture, he threw something in that skipped like a stone, followed by another, and another.

The next day, I headed for home. The trip out was as tough as the one in, but lonelier. It sounds odd to miss a woman who might have killed me, but I'll always wonder whether she realized we were kindred spirits, or knew in her final moments that in losing herself, she saved me.

Back home, I used her money to pay off Trevor's nanos. Then, as soon as the lease was up, I moved a cot into my office. Not exactly high-class, but at least I'm solvent, and it's another reason I'll always think kindly of Megan.

Someday, when my divorce is final and I get my savings unfrozen, I'll pay off the rest of my nanos. Then maybe I'll actually make some of that bad art. Or maybe it will be good art and I'll become famous. More likely, by that time the world will again be coming down around everyone's ears. Because one thing I'm sure of is that ideas can't be suppressed forever—and if it's possible to develop a nano that reads moods, it's probably possible to invent one that creates them. Such as LOVE ME or LET ME MANAGE YOUR INVESTMENTS or VOTE FOR X.

If I see it coming, I know where I'm going. Darryl could use a mining partner. And if he tells me he knows of rich diggings, I know I can trust him to a degree unique in the history of mining.

Every few months, he puts a carefully worded classified ad in *Goldbug* magazine so that when the time comes, I'm sure I can find him. ■

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Science Fact

The Right Stuff: Materials for Aerospace and Beyond

Kyle Kirkland

In the 2000 movie *Battlefield Earth*, aliens have invaded the Earth in order to mine its metals, particularly the "most valuable" metal, gold. The overwhelmed and technologically inferior humans are reduced to living in primitive societies, continually hiding from the aliens, who use Earth captives as slave labor.

A lot of people hate this movie. To me it's entertaining, despite its flaws—the aliens remind me too much of 1930s gangsters, but I can overlook that. One thing in the movie really bothers me, though: the aliens' motivation for invading the Earth. *Metal?* You mean a civilization that can build an interstellar transporter still relies on a metal-based industry and economy?

I doubt it. Even we of early twenty-first-century Earth—who still putter around in pollution-belching, accident-prone cars—are being weaned from our dependence on metal. The Bronze Age and Iron Age are long past. Swords and cannons are quaint antiques, and although steel continues to make the frames that hold up skyscrapers and the rails and trains that move cargo, the importance of metal is diminishing. SpaceShipOne, the ship built by Scaled Composites which won the X PRIZE in October 2004 by achieving an altitude of 100 kilometers (62 miles) twice within two weeks, was made out of graphite (a form of carbon) and epoxy.

New materials are needed, and not just because of a scarcity of old ones. Materials for any engineering design must have specific properties, and without the right material, the design stays on the drawing board. Engineers often dream up ingenious devices that can only be built with "unobtainium" or "no-such-thingium." For instance, the development of the jet engine lagged behind the piston engine by decades, but not because jets were unknown—engineers knew about them all along. Jet airplanes first appeared in the 1940s because

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that's when people could make parts, particularly the turbine blades, that didn't melt under the conditions in which a jet engine operates.

Some of the biggest dreamers have always been people who think about flight and space travel. NASA's space shuttle contains advanced materials because it's the only way to get a machine to and from orbit without roasting. The thermal tiles (made from silica), now famous for the gap filler incident in *Discovery*'s 2005 mission, must endure a temperature of thousands of degrees during the shuttle's reentry. And since NASA wants to replace the aging shuttle fleet, now more than ever it needs The Right Stuff—the best materials for the job.

Plastic Planes and Spaceships

Suppose you walk into your local car dealership with a request. "I want a car," you say politely to the salesman, "that never rusts even if I park it at the beach in the summer or drive all winter on salted roads. The car must be able to withstand a crash at 70 miles per hour, and weigh less than a thousand pounds so I can get great gas mileage. And it can't cost much because I'm poor."

If you get anything but a strange look, you're doing better than I did.

Perhaps one day the car I was asking for will be built with metal, but more likely it'll need other materials. Metal has its uses—jet engines still require "superalloys" such as nickel-based alloys, for example—but metal's got problems, too. It's strong but dense—and in the space and aviation business, mass is a killer expense. Carrying around extra weight means you burn a lot of extra fuel. Even worse, increasing the amount of fuel on a space launch adds more mass to the ship, which therefore requires yet more fuel to achieve escape or orbit velocity.

Metal's problems don't end there. Metal can be difficult to shape, it often corrodes, and it suffers fatigue (which is a weakening of the material due to periodic stress).

Composite materials use combinations of materials, and with the right mix you can get just about any property you want. They're not a new idea: thousands of years ago, Egyptians were making bricks from mud and straw because the combination was a better structural material than mud alone.

Today, composites are made of a stiff fibrous material glued with another material, called the matrix, which forms a structural web holding everything together. Common matrix materials are ceramics, polymers (long chains of molecules) such as epoxy, or sometimes metal; fibers are commonly made from glass, boron, or carbon.

Some people use the word "plastic"—technically, a material made from polymers—to describe just about any material that isn't metal or ceramic, and the word is sometimes used with little affection. Recently the American Film Institute composed a list of memorable movie quotes, and number 42 was in 1967's *The Graduate*, where Dustin Hoffman receives a one-word piece of advice on the best career opportunity: "Plastics." I'm not sure why that line is so memorable; does the word conjure up a sense of irony? Useful yet insubstantial?

For some people, perhaps it does. As materials scientist J.E. Gordon recalled in his book, *The Science of Structures and Materials*, in the years after World War II some of the engineers who wanted to design nonmetal components for airplanes had a great deal of trouble. No airplane could fly at the Royal Aircraft Establishment at Farnborough, England, without approval of the Structures Department, but because of their bias for metal, any plastic structure had to be 50% stronger than a comparable metal component. Not equally strong, but 1.5 times stronger.

Plenty of other examples exist. I recall a friend who owned one of those old

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mid-twentieth-century cars, a two-ton metal monster. One time a driver smashed into the rear bumper of my friend's car and damaged her car's front end pretty good. My friend's car was barely scratched—he spat on the bumper, wiped it clean with a rag, and it was good as new. He looked at the other car and said, "They don't make them like they used to."

It's true. The fiberglass of modern car bodies is lightweight but can be brittle. But another reason modern cars damage easily is because they are designed to have crumple zones to absorb the energy of impact, unlike the indestructible, solid steel cars of the good old days. If my friend had ever been going fast and hit something in that old car, the steel shell would have rung like a bell—and he would have been the clapper. Even wearing a seatbelt, he'd have suffered serious injury. (No air bags in that good-old-days car.)

The right material for the job is sometimes metal, but sometimes—and increasingly often—it isn't. A carbon composite enabled the super-light Voyager airplane (which was made entirely of composite materials) to circle the world non-stop in 1986. Try *that* with lead or steel.

Unfortunately the aerospace industry frequently seems to have a fixation with metal. Not lead or steel, of course, but rather aluminum and its alloys. Fine materials, to be sure: aluminum is nearly three times less dense than steel, but is strong and doesn't corrode as easily. Another important feature in flight materials is stiffness: most of the time you want to avoid bending or twisting, and aluminum handles torsion fairly well.

Aluminum's combination of stiffness and light weight makes it a good choice for many aerospace applications. What's more, metals are usually isotropic—they have the same properties in any direction—so it's easy for engineers to design the structure. Composites are typically expensive (though aluminum isn't cheap either), and they're generally not as simple as an isotropic chunk of metal.

But it's this variety and range that make composites the only choice in a growing number of applications. Composites can deliver good performance at an ultralight weight, and although fabrication can be complicated, putting together the parts doesn't require as many rivets or fasteners. Believe it or not, that alone is important.

One of the first aircraft to use composites extensively in the structure and wing was the AV-8B Harrier jet in the 1980s, in which about a quarter of the weight was from composites. One of the latest fighter jets, the F-22 Raptor, is about a third composite in its structural weight.

In contrast, much of the commercial aviation fleet is still aluminum. The big Boeings and Airbuses of today make use of composites, but the structures are mostly metal. Half of the weight of the Boeing 777, for example, is from aluminum.

Why is the military using "plastic" a lot more than the big passenger jets, even though the military isn't known for making weak, wimpy planes? The reason is the same as before—the right material for the right job—but the right material is often based on economics and logistics as much as engineering.

Composites tend to be lighter than aluminum alloys, but are more costly and require more maintenance. (That's not true in all cases, but it generally holds.) Despite the fact that airlines haven't been making any money lately, their reason for existence is to make a profit. In the past, their economic plan has been to pay a little more for fuel, due to heavier planes, but save on initial cost and maintenance.

The military has other goals. A fighter pilot's life may depend on getting an extra burst of speed from his plane at a crucial moment, and the last thing he wants is to tote around unnecessary weight. Newton's second law: accelera-

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tion equals force divided by mass.

How about NASA's space shuttle? You might think that the orbiter is mostly made of some kind of fabulously advanced composite material. If so, you'd be wrong.

The structure of the orbiter has nine major sections: the forward fuselage, wings, mid-fuselage, payload bay doors, aft fuselage, forward reaction control system, vertical tail, body flap, and control system pods. The majority of these structures are plain old aluminum alloy.

The forward fuselage, for example, is made of over 2,000 aluminum alloy panels, frames, and bulkheads. The wings are aluminum alloy, with a corrugated spar web and truss-type ribs. Most of the other sections are also aluminum. Rivets and bolts hold everything together. The space shuttle has advanced materials—the heat-resistant tiles, for instance—but by and large, it's metal. In an age of high-tech composites, the space shuttle is still mired for the most part in the metal age; that's like a nineteenth-century messenger who ignored the pony express and instead relied on a wallowing old ox.

Okay, so I know that isn't quite fair. Metal alloys containing aluminum, titanium, beryllium, nickel, or other elements can be just as high-tech as composites. But when you're fighting the ancient wisdom of the metal age, it's hard to play nice.

Even the commercial aviation industry is waking up. Boeing suddenly decided to welcome the twenty-first-century with the design of their newest ship: the 787 (formerly 7E7) Dreamliner. For the first time, the majority of the weight of a big passenger jet will be from "plastic."

It's a bold move—almost a bet-the-ranch type of move. Boeing has been in trouble lately because of gains made by their major competitor, Airbus. Boeing, known for its stable of passenger jets like the old reliable 737 and 747, along with the newer 767 and 777, is going composite with the 787. The structural weight of the 787 will be about 50% composite, 20% aluminum, 15% titanium, 10% steel, and 5% other materials. Compare that to the 777, which is 50% aluminum and 12% composite.

Boeing apparently thinks the time is right for composites. According to the pre-delivery sales figures, they seem to be correct. Boeing has already received hundreds of orders for the 787, making it one of their fastest-selling models of all time. Buyers seem to like the price: the 787 retails for 120 million dollars, less than what people had expected to pay.

It seems like a good buy. Boeing engineers say that the 787 will be 20% more fuel-efficient than other, same-capacity passenger jets. Part of this greater efficiency is due to engine and aerodynamics advances, but part of the reason for the better gas mileage is due to the lighter weight—the 787 will be about 30,000-40,000 pounds lighter than Airbus's A330-200.

Composites have other advantages. Since the material doesn't corrode as much as metal, the 787's cabin can be pressurized and humidified to a more comfortable degree. (To me, having suffered from sinus attacks during flights, this is a *huge* plus.) The superior strength of the material will let Boeing install bigger windows—another big plus for an inveterate window-gazer like me. And with composites, Boeing can manufacture the plane with bigger, fewer parts, saving time and effort. One section of a metal fuselage typically needs 1,500 aluminum sheets fastened with about 50,000 rivets, while the composite material needs only about a fifth as many fasteners.

Boeing engineers have decided the main composite material will be made of graphite with a matrix of toughened epoxy—rather like SpaceShipOne. The wings will also have titanium-graphite composites. The company has scheduled the 787's maiden flight for 2007.

The design stunned Airbus, Boeing's competitor. After initially decrying the

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design as a space-age fantasy, Airbus is now awash in murmurs about making a similar aircraft (and may have already made an announcement, one way or another, by the time you read this). That would be the highest series of compliments a competitor can pay: first deny, then imitate.

NASA has a similar decision coming up as they design and build a replacement for the space shuttle. Perhaps they should follow Boeing's lead, rather than making another golden calf.

Don't get me wrong. Like many technogeeks, I have a fondness for the space shuttle. Yet in my opinion, the space shuttle never really fulfilled its goal of making space launches relatively affordable.

Would composites do a better job than aluminum? NASA may be gun-shy. Lockheed's X-33—which in the 1990s was deemed a prototype of the shuttle's successor—had a big problem in 1999 with cracks in some giant fuel tanks, which were made out of composite materials. Engineers decided to replace the composites with—you guessed it—aluminum. Didn't matter, since the program was axed a few years later.

There's no doubt that composites can be temperamental. And with every new and risky design, the first time something goes wrong there's always someone to say, "Told you so."

So you have to be careful. And it seems to me that many people today are more interested in propulsion methods than new materials. It makes for impressive results: the X-43A, for instance, broke jet speed records in November 2004 when it reached Mach 10 (about 12,000 kilometers/hr—7,000 mph) using a scramjet engine. A scramjet is simpler than a conventional jet engine because it doesn't use a compressor; normally the air to support fuel combustion needs to be compressed in order to provide enough oxygen in the chamber, but a scramjet allows air to enter at high velocity and ram itself into compression. (Obviously this only works when the craft is traveling at a high rate of speed.) A scramjet doesn't do anything for you in the vacuum of space, but it could be used as a first-stage propulsion unit for space launches.

Friction at Mach 10 caused temperatures to rise to well over 3,000°F, and the leading edges of the test craft had to be surfaced with carbon composites. But it's the speed of the ship that made the 11 o'clock news.

And yet, if the material you need to make a fully operational craft is unobtainium, it's not going to fly no matter how ingenious the blueprint or the prototype.

NASA has been pretty much all over the place when it comes to replacing the shuttle. These days they talk about something called the Crew Exploration Vehicle (CEV), the specifications of which seem to be influenced by President George W. Bush's goal of manned missions to the Moon and, later, to Mars. NASA wants to retire the shuttles by 2010 and have an operational CEV shortly thereafter.

I'm worried. To think that you can go from the drawing board to an operational craft as complex as this in a few years is a hallucination of the most dangerous sort. And to fit the design, testing, and revising phases into this short period of time, corners will be cut. The result might please technoconservatives, but I think it has a good chance of producing another metal cow—probably one that looks remarkably similar to the current version of the space shuttle.

However, perhaps I'm worried over nothing. NASA has always invested in materials research, and they know it's paid off. Other people know it too; many people realize that high-tech materials have probably been the most important commercial offshoots of space technology thus far.

For example, artificial limbs, crash helmets, and similar devices have been greatly improved by materials originally

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developed for purposes much different from prosthetics or bicycle safety. Recently obstetricians began training with forceps made with NASA-developed composite materials, along with embedded fiber optics. Doctors use forceps to position an infant during delivery, but a baby's head is soft (the skull bones are still relatively far apart) and too much pressure can have disastrous consequences. The fiber optic sensors help the physician to monitor pressure, giving medical students excellent training before they have to use forceps for real. These materials, by the way, came from the X-33 program's fuel tanks.

Granted, for some jobs it's impossible to replace metal (at least at the present time). But for weight-critical space launches, a long look must be given to composite frames.

Shapechangers

Most of the time engineers design static structures that don't respond to the environment. Unlike animals, which collect sensory information in order to move about and adjust to their surroundings, machines are made of "dumb" materials that perform their function in a single way. Even materials such as composites, which can be tailored to suit a wide variety of parameters, are not adjustable once set in place.

Making one size fit all results in serious inefficiencies. Consider airplane wings, for instance. The job of wings varies, depending on whether the plane is landing or taking off, making haste or cruising at high altitude. Aerospace engineers try to account for this by giving wings movable surfaces so that they are more adaptable. The pilot raises or lowers ailerons to turn, and wing flaps can be extended or retracted to change the lift during take-offs and landings.

But there's just so much you can do with simple adjustments like these, and they add to the weight of the craft. "Smart" materials that adapt to changing conditions would prove far superior. And this is the way of the future in materials science.

Adaptive materials are already making their mark. Ground-based astronomical observations suffer from distortions due to rapidly changing atmospheric conditions, even when the observatory is located high on mountaintops (as many are). At the Keck Observatory on Mauna Kea, in Hawaii, as well as at other observatories, astronomers are fighting this problem with techniques called adaptive optics. The reflective telescopes are made with "rubber" mirrors—thin, deformable mirrors, changing shape at hundreds of times a second in response to shifts in the atmosphere. The system senses atmospheric changes by analyzing a reference light, which can be a bright star or, in the latest configurations, a laser beam that travels up into the atmosphere.

Surprisingly, shapechanging isn't new at all in aviation. The first viable airplane, built by the Wright brothers, had wings that were twisted by pulleys and cables. Inspired by the flight of birds, Wilbur and Orville guided and stabilized their plane by adjusting the wing shape.

The Wright brothers' aviation success caught on, but the flexible wings didn't. Higher speeds rip and destroy fragile surfaces, so ye olde flimsy wings were discarded, and stiff wings became essential. Movable panels took over the job of turning and changing altitude. Engineers started getting fancy a few decades ago, making planes like the F-14, whose wings pivot back and forth. That's fine, but it's still a space age away from what I would call a "morphing" wing—a wing that can alter its shape at will.

But new materials may soon make this possible, opening up a new era in aviation. And it may not be limited to those of us on the planet Earth.

Some of the new materials are called shape memory alloys. These special materials "remember" and can be "trained," so they can recover an original geometry—and apply a lot of force

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in the process—with the application of some stimulus, such as heat. One set of shape memory alloys are known by the name Nitinol, and contain roughly equal mixtures of nickel and titanium, along with some other elements to fine tune the properties.

Since I have a bias for plastics, I'd rather talk about shape memory polymers. These materials can go from rigid to floppy and then back to rigid again, all under the command of various stimuli such as heat, electricity, or light (as recently demonstrated by researchers Robert Langer, Andreas Lendlein, and colleagues, as reported in the 14 April 2005 issue of *Nature*.) The changes don't, or at least shouldn't, weaken the material. Some of these polymers allow a doubling or more of their length, then a return to the smaller size. One proprietary substance is called Veriflex™, developed by the Cornerstone Research Group.

Engineers are thinking today about wings with drastic shapechanging capability. Structures can suddenly form and shape themselves, do a job—such as turn the plane or provide extra lift—and then disappear, so there is no weight penalty to be paid by having to carry attached structures to perform these functions. Even wings themselves can open and disappear, like gigantic bat wings.

Of course, you have to start small, then think big. Right now people are working on shapeable wings by using simple actuators such as piezoelectric devices (in which electricity causes mechanical alterations and vice versa). Small changes won't cause much of a difficulty, but if you make major structural changes you might end up with gaps. Gaps are a problem because they can act like aerodynamic brakes. A shape memory polymer might be essential to close off the gaps, maintaining the wing's low drag profile.

Wings are usually made with a skeleton of parallel spars wrapped in a skin, either aluminum or composite. In general, the spars keep the wing from bending and the skin keeps it from twisting. Clearly these wings won't morph because the aluminum or composite skin isn't elastic; morphing wings would need to be segmented and/or have shape memory polymers or other flexible materials. Yet these materials must be able to tolerate the serious forces encountered during flight.

In the last few years, people at NASA, Boeing, and the Air Force Research Laboratory have been working on a concept called the active aeroelastic wing. These researchers have been using an F-18 fitted with thin wings, which were part of the plane's original design, but rejected during the testing phase because they twisted too easily. Now engineers are thinking that twisting isn't so bad, if you can control it. The idea is to figure out a way to use the *whole* wing to steer and maneuver the plane, instead of adding flaps and ailerons and paying a significant weight penalty.

I expect that we might see adaptive wing structures in a few years, but the more ambitious programs may take a long time. One of the biggest problems occurs during the transition from one shape to another. When you're in the air and you want to make a change (such as folding or unfolding a large structure), you're going to have to deal with stability issues. It would be like two guys in a small bass boat who want to switch seats: once they get settled they're fine, but while they're crossing each other in the middle they're likely to tip over the boat.

But people are working on these projects because the rewards would be great. DARPA (Defense Advanced Research Projects Agency) has begun a Morphing Aircraft Structures program with the goal of developing more versatile aircraft. With present technology, you can make a plane that excels at reconnaissance or a plane that's good for attacking, but not both. Yet doing both is theoretically possible. Think of a pere-

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grine falcon, which spreads its wings to soar and sweeps them back to dive at two hundred miles per hour. That's what the military wants.

Civilian uses of this technology would be, in my opinion, even better. If you want a plane that can maneuver in close quarters, such as a congested urban area, you need something that can dance in the air—sharp spins, dives, and turns. To do that, you really need a shapechanger. The "air car," that conventional prop of science fiction, would be possible with a morphing structure, as would Batman's amazing flier (which in the movies seems to defy a significant number of aerodynamic principles). Recently engineers at the University of Florida, funded by the Air Force and NASA, have constructed drone prototypes that have morphing wings and are highly agile.

Versatile aircraft would also have plenty of other-world uses. If you need a flying craft that can efficiently explore and maneuver in varied conditions, you'll want a morphing craft. Our Moon has no air and thus no aerodynamics, but the solar system is diverse, ranging from the thin atmosphere of Mars to the thick atmosphere of Venus, and the outer gaseous planets pose even more challenges. Exploration among the diversity of solar system environments, including within the same planet or satellite, may require a craft with a morphing structure, as it would be too expensive to design, build, and launch a different craft for each of these different situations.

Just to prove that my bias against metal isn't complete, I'll mention one last material: metallic glass. The 1991 movie *Terminator 2* contained a creature made of flowing metal that could reshape itself at will. Such a material doesn't exist yet, but some of the newest metals have taken the first few steps toward this end. Liquidmetal® Technologies, in Lake Forest, California, makes metal alloys that are amorphous, like glass, rather than crystallizing into a geometric structure, like conventional metal.

The company says that their Liquidmetal alloys are superior to crystalline metals in numerous ways. They have developed zirconium-base and titanium-base Liquidmetal alloys that have two times the strength of conventional titanium alloys. (In the spring of 2005, the company announced that SanDisk Corporation—whose flash drives I use all the time—will make some products with Liquidmetal alloy. This is good news, since my pocketed flash drives often take a beating.) The company also claims that intricate structures are far easier to make with their alloys, due to their superior casting and phase transition properties. And Liquidmetal alloys are elastic and have a shape memory, so they can retain their form even after severe stress.

The company says some of its products have already been tested during four space shuttle missions, and were used on NASA's Genesis mission. (This mission, intended to collect solar wind samples, had an unfortunate end when it crash-landed in 2004 due to a parachute failure.)

One can imagine self-healing spacecraft made from these materials. A hole opening up in a ship due to a small-particle impact would be a disaster for a rigid craft, but if the skin could automatically reseal itself, little air would escape. Not only would it be safer, it would also mean that ships need not be so heavily armored, saving on fuel and the huge weight expense at launch.

Of course the ideal concept of a complete shapechanger will not be feasible anytime soon, no matter what material is contemplated for its design.

Yet we're moving closer to a specific goal that's been on the minds of engineers (and science fiction enthusiasts) for quite a while: machine mobility, as effective as a human's movements. People are agile because of active elasticity—muscular contractions governed by the nervous system. "Smart" materials

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that can change under various stimuli could make dynamic structures as flexible and agile as the human body.

New materials are coming, and their impact on the world will be as great as the Bronze Age, the Iron Age, and the Industrial Revolution. Whether these materials are made from composites, polymers, ceramics, or metal, they will make a host of things possible that had been just drawing-board dreams before. They may even exceed the amazing capability of the human body—and won't wear out after a mere three score and ten years. ■

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About the Author: Kylé Kirkland earned a Ph.D. in neuroscience from the University of Pennsylvania in 1998. He's interested in many different fields of science and technology, and recently completed a book for young adults on optics (*Optics: Illuminating the Power of Light*, with Sean M. Grady, to be published by Facts On File). This article is his fourteenth appearance in *Analog*.

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Kyrie Eleison

John G. Hemry

"The best-laid plans. . . ." applies to *everybody*.

Frost rimmed the large, thick windows looking out over a cliff and down to dark water flecked by whitecaps. Sleet rattled against heavy stone walls as an erratic wind swept by. Low on the horizon, a reddish sun glowed through a rare small rent in the clouds that otherwise covered the sky, casting long shadows across the room where Garvis Skein lay abed, snoring heavily under the pile of blankets he favored for warmth.

Francesa walked quietly into the room, her uncovered feet making almost no sound, ignoring with the stoicism of years of experience the searing cold on the soles of her feet whenever she had to leave the comparative comfort of a rug's surface and cross bare stone. Working silently and swiftly, she pulled tinder and coal from the bag she carried and, kneeling in front of the stone fireplace in one corner, got a fire going with efficiency born of long practice.

Garvis stirred under his covers. Francesa froze, her breathing as shallow and quiet as possible. The fire popped, and Garvis' eyes opened, frowning at the ornate designs carved into the ceiling. The eyes slowly pivoted, coming to rest on Francesa. The man's eyes narrowed in annoyance. "You have broken a rule," he muttered. "Noisemaking during sleep period. Inform the duty Officer so he may order the appropriate punishment."

Francesa bowed her head silently, then brought her right hand up to touch her forehead. "Aye."

"Go away." Garvis turned to settle under his blankets.

Francesa snarled at his back, knowing the man wouldn't move again until the fire had warmed the room. Then she left as silently as possible.

Officer Varasan was lingering over breakfast when Francesa found him. One look at her expression and he sighed heavily. "Now what?"

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Francesa stood before him, trying not to notice the crumbs on the shirt that stretched over his belly. Her stomach threatened to rumble, something she tried to silence with every fiber of her being. On those few occasions when she and her like were granted good bread, their sunken stomachs offered no purchase for any crumb. "I made a sound, Officer," she stated tonelessly. "Before call to work."

Varasan sighed again. As Officers went, he wasn't so bad, Francesa thought. But he was an Officer. "Where?"

"The chamber of the First Officer."

This time Officer Varasan flinched. "Stars, girl, couldn't you have picked a less important place?" He let out a long breath of air, a gust the warmth of which actually brushed against Francesa. "Though as you well know every place is less important than that." He toyed with a remnant of pastry, oblivious to the way Francesa couldn't avoid staring toward it. "Two lashes. After the morning Report."

Francesa's body tensed, then she nodded, once again bringing her right hand to her brow. "Two lashes. After the morning Report."

Varasan flipped his own hand into the general vicinity of his brow in response, then went back to his meal, ignoring her as she left.

She veered through the kitchen, coming to a halt near one of the cooks. The cook glanced down at her and smiled. "Francesa. What brings you here?"

"Are there any leftovers?" she asked, trying to keep the neediness from her voice.

The cook's smile turned rueful. "Before most of the Officers and Crew have even eaten? Not likely." He turned away, hesitated, then shoved something toward her. "This bit was ruined by a new apprentice. Get rid of it, will you?"

Francesa took the roll, her hands shaking. "Aye."

The cook glanced at her for a moment. "The harvest isn't too good, I hear."

Francesa nodded. "My friend Ivry works the fields." As bad as working around the Officers and Crew could be, at least most of the time Francesa was sheltered inside. Those in the fields took the brunt of the weather for their entire work shifts. "She says the weather went cold too early."

"The weather's always cold," the cook remarked gloomily, his eyes straying toward a high slit window where a small patch of pale sky could be seen. "Though it seems colder now, in truth. Will there be enough food this year?"

"I . . ." Francesa looked down at the roll in her hand. "I don't know."

"Not enough, maybe," the cook murmured. "Third year in a row. Not that there's ever been enough, not since I was younger than you, but it's worse lately. The Officers say the Captain's angry with us. And the Officers and Crew must be fed before workers like us. Captain's orders." He touched his brow with his right hand.

Francesa kept her face calm despite the anger that surged inside. Nodding politely, she hastened from the kitchen and wolfed down half the roll. She managed to pause after that, staring down at the bread and thinking of a little brother with a belly as thin as her own. Biting her lip, she wrapped the other half carefully in a scrap of rag and stuffed it into a nearby hiding place where it would be safe until her work shift finished.

The morning bells sounded, calling them to Report. Francesa joined a slowly growing column of workers like herself as they shuffled toward the Bridge. Once inside, she shoved her way toward the back, finally leaning against the cold stone and looking upward. Carvings rioted across the stone above, telling the story of the Wreck and the Survival, the Ordeal and the prophesized Rescue. Francesa felt the cold reaching through the thin cloth of her shirt, sinking into

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her back, and forced herself to stand away from the stone wall. She'd have to do it soon, anyway.

The lower area filled with workers, some of them casting wary eyes on the members of the Watch who also entered to stand lining one side of the room, while other workers steadfastly pretended to ignore the Watch's presence. With security assured by the Watch, the members of the Crew filed in, proceeding to their seats on long benches set on a platform raised a few feet higher than the floor on which Francesa and her peers stood. Francesa rested her eyes on the seated backsides of the Crew and remembered for a moment that she'd once been able to find humor in that view.

After the Crew came most of the Officers, going to individual chairs placed in front of the Crew benches.

Then the Third Officer entered, standing and looking around to ensure everyone was ready. "Attention!" he yelled.

The Officers and Crew came to their feet, standing rigid, while the workers around Francesa shuffled into more erect postures.

First Officer Garvis Skein entered and walked slowly to the third level of the Bridge, set a few feet higher than that on which the Officers' chairs and Crew's benches rested. The third level was much smaller than the other two, bounded along the back by a semicircular shelf of stone. On the stone shelf, which had been polished smooth and shiny, were set many polished stones of various sizes and colors, their settings forming patterns on the slab of stone.

Garvis stood before the small shelf of stone, waiting until the Third Officer handed a lighted lamp to him. He waved his light over the shelf, making the flame dance and causing the polished stones to wink rhythmically in time. "All systems report errors," he intoned, then paused.

His audience chorused the reply, the Officers and Crew loudly and enthusiastically while the workers spoke the words with varying degrees of emotion. "Corrective action required."

"All systems failing!"

"Corrective action required," the reply came again.

"Our actions have failed! The Captain orders us to leave the ship!" Garvis thundered.

"Show mercy, Captain!" the audience cried.

"Rescue will come!"

This time the chorus held the note of finality. "For those who trust in the Captain!"

Garvis sat down the lamp, turning to face the crowd full on. "Those who trust in the Captain will be rescued! They will be taken up to the stars from whence we came and live in a place of plenty with the Captain just as our ancestors did. Those who do not follow will be left behind to toil in this world of pain to which our ancestors were banished for their failures to serve the Captain well."

Francesa had heard it all so many times she could have recited it in her sleep. She tuned out the droning voice of First Officer Garvis, thinking of the cold, the poor harvest, and the thin bodies of those in her family. When the call to duty was made and everyone bowed their heads as Garvis intoned thanks to the Captain along with promises of obedience in all things, Francesa couldn't help wishing the Captain would send them something better than a promise of eventual rescue. After well over two hundred "standard" years, as carefully measured and recorded by the Second Officer, she didn't see rescue coming with nearly the certainty of hunger and cold.

But she didn't say such thoughts out loud. Two lashes today would be bad enough.

First Officer Garvis eventually finished his instructions, holding up a copy of the writings with reverence. "Here are the rules, set forth by the Captain. Heed them. Always ask your Officers for what

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the rules say and what they mean. Do not attempt to read them yourself and spurn those who offer what they claim to be true copies. They are only seeking to mislead you. Only the copies of the rules kept on the Bridge are the true words of the Captain, and only the Officers may read those rules, by order of the Captain."

Once again everyone touched their brows, Francesa thinking as she did so of her father's disdain over the claim that no one but an Officer should read the writings. Tattered copies still existed among the workers, treasured and read by any who asked. Francesa had read them herself, finding comfort in the old words and their firm advice on how life should be lived.

The First Officer left, followed by the other Officers, then the Crew. Even as the last of the Crew left the Bridge, stern members of the Watch left their posts against the wall and began herding the workers out. "Back to your labors! Earn the mercy of the Captain by your sweat!" The workers openly grumbled before the Watch, but went as ordered.

The Report had eaten up more than an hour, granting a tedious but welcome respite from work. Unfortunately, the remaining hours of the morning saw Francesa scrubbing the stone walls of the Crew's lodgings. After a short midday break and a too-small food ration, Francesa was ordered to tend fires again.

The afternoon was well along before that task was handed off to another weary worker. Francesa peered through a high window at the light, judging the time left in the work day, then reluctantly headed for the quarters of the Watch. If she didn't get her lashes soon she might not get them today. She didn't particularly care if that displeased the Captain who had already banished them to this cold hell, but the displeasure of First Officer Garvis could be an ugly thing to bear. If he found out she'd avoided being punished two lashes would seem like a mercy compared to the First Officer's righteous wrath.

Francesa went across a cold passage and down the slope slightly to the dwellings of the Watch. Two members stood at their station, waiting for whatever task either Officer or Crew might demand.

Francesa walked toward the Watch station, already feeling her back muscles tensing in anticipation of the bite of the lash. As she stood before the Watch members, ready to report, something distracted them. Both turned to look further down the hill, their mouths dropping open and their eyes staring. Francesa couldn't help looking in the same direction.

She wondered if her own mouth had fallen agape. Something very large, larger even than the Bridge, was dropping gently down from the sky, shining even in the dim light of the red sun which managed its way through the ever-present cloud cover. The great object, moving silently, came to rest in the big courtyard which separated the homes of the Officers and Crew from the houses, farms, and workshops of the workers.

"The Captain has come," one of the Watch members gasped. He turned to Francesa, smiling like a drunkard. "He's come to take us up!"

Francesa was still staring when the man turned and started running, down through the upper quarters and toward the round shining object as it settled onto the stone of the courtyard. Even from here, Francesa could see the heavy paving stones buckling around the edges of the huge craft.

But she didn't smile and she didn't run. Her mind full of a strange haze, Francesa veered off to recover the half-roll which she'd hidden that morning, then walked slowly toward the courtyard. There seemed no reason to run. If the Captain had truly returned, he certainly hadn't done so for her.

Most of the other workers seemed to feel the same way. As a column of Offi-

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cers and Crew hurled themselves toward the strange object, crying out devotions to the Captain, the workers followed behind, moving with a sort of quiet resignation.

By the time Francesa reached a point near enough the thing to see and hear what was happening, it seemed the entire town had gathered around it. Closest were the Officers and Crew, most with faces beaming in anticipation. The Watch stood behind them, their faces both hopeful and worried. In the outermost ring stood the workers, shivering in the cold, their numbers far larger than the others, craning their necks or climbing on anything that might offer a view. Francesa scrambled up on a column marking one corner of the courtyard, putting her toward the very back, but giving her a fairly clear look over the heads of most of the crowd.

Garvis Skein stood closest to the strange object. Francesa narrowed her eyes, but couldn't tell if Garvis was really shaking with either fear or excitement.

With absolutely no warning or fanfare an opening appeared low in the side of the object. The rectangle seemed large enough to hold several people, but only two stood there. A low moan swept across the crowd as the two stepped down to the stones of the courtyard. Francesa squinted again, trying to make out details, then as the two walked forward was able to tell one was a man and the other a woman, though both were garbed in outfits which seemed impossibly wonderful to her eyes.

The two stopped before Garvis Skein, standing side by side.

Garvis raised his right hand to his brow. "The First Officer greets you in the name of the Captain!" he cried. Then, his voice holding the first note of humility Francesa had ever heard from Garvis, a humility she was sure was totally false, he spoke more quietly to the man. "Are you the Captain's image upon this world?"

The woman cleared her throat. Garvis gave her an annoyed look before focusing back on the man. "We are obedient followers of the Captain. As you know, of course," Garvis added hastily.

The man spoke with apparent care, his voice oddly accented, his eyes looking toward the woman. "If you want the captain, I can introduce you."

"He's not here?" one of the other Officers blurted.

Garvis shot an ugly glare toward the offender before smiling at the man again. "But if you are the Captain's image, or . . . or representative . . ."

The woman finally spoke, her crisp voice carrying clearly to Francesa. "If you want the captain—"

"Excuse me," Garvis interrupted with a frown. "I know you accompany the Captain's representative, but I am the Captain's First Officer. I speak to Him and to his other Officers." Garvis ended with a smile toward the man.

"The Captain's a man?" the woman asked, sounding not the least abashed by Garvis' rebuke.

A shocked murmur ran through the crowd of Officers and Crew. Garvis frowned again, deeper this time, his face reddening in a way Francesa knew all too well. "Of course the Captain is a man. It is clear that only a man can be the Captain. How could it be otherwise? The Captain we knew was a man, every First Officer chosen to speak for Him on this world has been a man, and it has been foretold that He will return. Is this a test?"

Far from appearing intimidated, the woman smiled tightly. "Perhaps it is a test." The man with her started to speak. "Oh, no, Kayl. Let this *man* tell you what he wants to say."

The man addressed as Kayl nodded at the woman's words. Francesa watched, her puzzlement growing. The man Kayl actually seemed to be deferring to the woman, though if he was an Officer or even Crew, she couldn't possibly have any authority over him. And surely Kayl

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was an Officer. Who else could have come in such an amazing craft?

But First Officer Garvis seemed oblivious to the by-play between the man and woman. He faced the man called Kayl, his arms spread wide. "We are ready to depart with you."

Kayl's face grew wary. "You're descended from survivors from the *Verio*, right?" A murmur arose from the crowd and everyone, Francesa included, brought their right hands to their brows at the mention of the ship's Name. Kayl seemed startled, then nodded. "This is a pretty empty area of space. Ships very rarely traverse it. We're only here because the *Bellegrange* was chartered to make some observations that required the properties of this part of space. That brought us close enough to detect the distress beacon the *Verio* left orbiting your sun. But even after we report on survivors here it may be a long time before anyone comes back again, since you do appear to be able to survive on this world independently."

Garvis smiled and nodded, even though Francesa doubted he really understood what the man had said. "You have come and that is all that matters."

Kayl shook his head. "I have to explain. That's important because even though our ship is much bigger than the one your ancestors came here on, the *Bellegrange* still has limits on internal space and life support. As much as we'd like to, we can't take everyone," he stated with the air of someone declaring an unpleasant but unchangeable truth.

Francesa felt her heart sink as the little hope there vanished. All around her, other workers slumped in resignation, but she could see Garvis and the other Officers and Crew smiling, and see how Kayl seemed surprised by the happy reaction among that group.

Garvis spread his arms again. "It has long been known that all would not be Rescued. That only those deemed worthy would be taken up to the stars again. The worthy stand before you, those who have accepted the authority of the Captain without reservation, who believed He would return for his chosen and obedient followers."

Kayl looked around, his expression wary, then at the woman with him as if, Francesa thought, he was seeking guidance, absurd as that seemed. The woman murmured something so low that even Garvis frowned over not being able to hear. But Kayl obviously did. He gave Garvis a confident look. "We'll need whatever census data you have. Information on everyone here."

The Officers and Crew shuffled their feet, looking at each other in open surprise. Garvis also seemed to wonder at the request. "Everyone? But—"

"Everyone," Kayl repeated firmly.

Garvis couldn't hide the puzzlement he felt, then an Officer behind him said something and the First Officer's face cleared. "Another test. Of course. Whatever you ask we shall provide." He nodded, his smile fading into the first traces of uncertainty. "And then we shall be taken up?"

"Once we've reviewed your information we'll be able to proceed." Kayl smiled reassuringly. "It'll take a little while."

Garvis managed another smile in return. "We have waited long already and can surely wait longer if that is the Captain's pleasure. We are obedient to Him." Once again Garvis touched his brow, a gesture mimicked first by the Officers and Crew, and then in a more ragged fashion by the workers watching from a greater distance. Then he waved his hand vigorously at the Second Officer, who ran off toward the Bridge.

Francesa watched the Second Officer go, knowing he was after the population records meticulously kept up to date and stored for safekeeping in the Bridge. Then her eyes returned to Garvis as the First Officer swept his hand around again, this time from the tone and volume of his voice addressing everyone in the courtyard. "The day of Rescue has

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come. The obedient faithful shall be rewarded. Members of the Watch! Pray you have enough obedience in your hearts to be among the faithful, and send the unworthy back to their labors."

The people making up the Watch turned and began shoving back the workers, yelling out commands. Francesa, far enough back to avoid their attentions for a few moments, gazed at the woman and the man Kayl, who were speaking together again. Both of those individuals seemed troubled, though by what Francesa couldn't guess. Perhaps they'd expected more worthies among the people who lived here.

An arm swept toward her as a member of the Watch aimed to dislodge Francesa from her perch. She dodged with the ease of someone who'd avoided blows all her life, scrambling down and joining the other workers as they hastened to their homes, occasionally looking back to the ship that sat like an impossible vision in the courtyard, forever out of their reach.

But once the workers had cleared the courtyard, heading down the slope toward their homes, the Watch turned back, forming a guard around the ship. Francesa joined up with some friends, but aside from the briefest of greetings, none of them talked. What was there to say? Finally Francesa grinned into the silence. "At least once the First Officer leaves, I'll never have to build his fires again."

A hand fell upon her shoulder, momentarily shocking her with fright, but then her father's voice came. "There's that, little lady. No stars for us, eh? Except the relief that'll come from being free of the 'worthy.'" A chuckle spread among the crowd, but it held little real humor.

Francesa's father used his hand to steer her to one side. "It'll be dark soon, and there's little sense in laboring more today. Come along. You're old enough to sit while we talk of this." They wended through the narrow byways of the workers' area until they reached a place where a cave mouth in a hill had been covered with roughly hewn stone. The door, formed of small boards hacked from the local vegetation, didn't fit its frame tightly, but was better than nothing at keeping out the weather. A moment later they were within the meeting hall, out of the bitter wind and seeking seats on the rough benches.

The room filled rapidly. Francesa ignored the smells of so many bodies, instead enjoying the warmth the crowd generated. Talking began almost at once, but after a while Francesa realized the conversations around her were going nowhere. What, really, was there to say? The judgment had come and here they sat downcast, while the Officers and Crew were doubtless dancing in the halls of the buildings around the Bridge.

Some length of time had certainly passed, for the gaps around the door showed nothing but darkness, when the aimless conversations ceased abruptly as the door opened and a woman stepped inside. Francesa watched her like the rest, able to tell even under the rough worker's cloak that she was too well fed to actually be a worker. Then the woman raised her head to return the stares and Francesa felt a shock of recognition. "The man Kayl's companion," she gasped.

Others had obviously identified the woman as well. A roar of talk arose, then faded into silence once more as the woman stepped away from the door. Francesa's father stood and walked forward to meet her, his nervousness plain to all. "You are, of course, welcome here."

The woman halted and eyed the roomful of workers. "Thank you. It wasn't too hard to manufacture a copy of your cloaks, though I see that didn't mislead anyone."

"The Watch is not here with you?" someone asked nervously.

"The Watch," the woman answered

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dryly, "doesn't know I walked through their ranks. My stealth gear isn't state of the art, but it's more than good enough for dealing with them." She eyed the group. "I wanted to talk to someone else. Someone besides that group that kept everyone else away after we landed. You seem frightened. Why?" To Francesa, the woman's voice held the same assumption of obedience that she'd always heard in First Officer Garvis, yet without the arrogance Garvis always carried around him like a second cloak.

Francesa's father looked around helplessly, saw that no one else wanted to answer, then spoke heavily. "We know you're here to judge. I suppose you've already judged. And every one of us knows we're not worthy."

The woman from the ship cocked one questioning eyebrow at him. "You're not?"

"Please do not mock us. We are here, we are workers, because we lacked the same wholehearted obedience to the Captain that the Officers and Crew claim. We know that."

"And how does this make you unworthy?" the woman pressed.

A woman worker finally stood. "You know this! You know that all that matters is a person's acceptance of the Captain as the only true leader in everything!"

"Interesting." The woman from the ship seemed to be looking inward for a moment. "What do you base this belief on?"

The silence stretched this time, then Francesa's father beckoned to an old man. "Give her the writings you carry. I don't know the meaning of all this, but we've nothing to lose by doing as she says."

As the old man approached the woman from the ship, he touched his brow, then offered the tattered pages. The woman from the ship frowned as she took the writings, then began reading them, at first slowly, then with greater speed until she seemed to be flipping through the papers as fast as their brittleness would allow. Finally, she looked up and around the room. "These are survival rules. Guidance for people whose ships have been wrecked." The workers exchanged worried glances. "Are you telling me you've created a religion out of these?"

The old man's face worked with a series of emotions, as if he couldn't decide how he should react. "We . . . we created nothing. These are the writings. The Captain told us to follow them. *He* followed them."

The woman's frown relaxed into solemnity. "They're good rules. They haven't changed significantly since the *Verio* was lost here. But your ancestors seem to have combined them with the existing religious beliefs the survivors already had. I have no doubt Captain Santere—" The crowd gasped at the open speaking of the name, causing her to pause for just a moment. "Captain Santere," she repeated sternly, "followed the rules laid out in these documents. But he wasn't a god. Some ship captains *think* they're gods, but that's as far as it goes," she added.

Francesa's father gazed at her in open wonder. "Why haven't you been punished for speaking His name? How can you say such things? Are you truly in the favor of the Captain?"

The woman looked cross. "This little joke has gone on far enough. I'm not in the favor of the captain. My name is Janis Balestra. I *am* the captain of the *Bellegrange*."

Silence fell across the room. Finally, Francesa's father spoke tentatively. "But . . . we've always been told . . . the Captain is a man."

"That's true. Captain Santere was a man."

"And all of his Officers were men. Only a man can be Captain and only a man can be First Officer and only men can be Officers."

This time the woman stared for a mo-

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ment, then laughed. "Our records show that the First Officer on the *Verio* was Francesa Nalus. She was very definitely a woman."

Quiet fell again, then Francesa's father shook his head, not in denial but in obvious disbelief. "We've been told that Francesa Nalus was one of the Crew, but an unimportant one. We've been told that the First Officer was Radick Junis."

"Radick Junis?" the woman questioned, then seemed to be talking to herself for a moment. She laughed again. "Junis was Fourth Officer on the *Verio*. Not even the third in line to command. The fourth. Yet somehow he managed to get the real First Officer written out of her place in history and stuck himself in there. Apparently he was a much better politician than he was an officer. The Fifth Officer was a woman, too. I guess she got written out of history as well." She folded her arms, staring around the room defiantly. "As I told you, I'm Captain Balestra of the *Bellegrange*."

Francesa couldn't help herself. Her whisper sounded clearly in the once-again silent room. "Then *you* decide who goes and who stays."

Captain Balestra frowned down at her, then slowly smiled. "Yes. As Mr. Kayl told your, uh, 'First Officer' back at the landing shuttle, we can't take everyone." A sigh seemed to pass over the group. "I don't know what your expectations are, but as Mr. Kayl stated, the *Bellegrange* is much larger than the *Verio* was. We can carry most of the people in this accidental colony. But not everyone."

"Most?" the old man questioned. "Not a few? Not some? Most?"

"Yes. Mr. Kayl is going over the lists provided right now to determine your current population and match that to our capacity."

The worker woman's face reflected a sudden hope. "Then, after you've taken the Officers and Crew, it may be that some of us will also be taken up with you?"

Captain Balestra scowled. "Why does everyone assume these so-called Officers and Crew will get any priority? The criteria used to choose who goes are up to me. I'm not supposed to make value judgments, but that's my call."

The old man shook his head. "But they are obedient. They have accepted the authority of the Captain without reservation. The writings say—"

"These writings," Captain Balestra snapped, her anger clear, "say due respect should be given to those in legitimate positions of authority and their orders should be obeyed as long as those orders are lawful. Have you actually *read* these survival rules? They're not about just being obedient. These rules tell you to look out for each other, to share resources, to work for the mutual good so as many as possible can survive."

Francesa's father, with a courage Francesa would never have suspected, stepped between Captain Balestra and the old man. "Please. Don't harm him. We know the writings say that. That's why we're here instead of being among the chosen. Because we didn't think giving obedience to the Captain was all that mattered, or even the most important thing in the writings. Because we'd help a sick neighbor even on the Day of Rest, or break the rules if following them seemed to lead to an injustice. The First Officer—all of the Officers and Crew—say such things are wrong because the Captain demands our obedience no matter what. If you mean to punish us for our actions, then so be it. We've only lived as seemed right, by the words in the writings. But don't harm this one. He says only what he was taught by those who live on the hill."

Captain Balestra stared at Francesa's father, her anger visibly fading. "I see. You have nothing to fear from me, sir. Not you and not this man, nor anyone here." She gestured. "You're thin. You're all thin."

"Yes. The harvests have not been good. Not for years."

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"You're to be credited for getting any harvests out of this land." Balestra jerked her head toward the door, indicating the outside. "This is a lousy planet. The best option you had in this system, but only an equatorial location like this has a chance of livable temperatures on a world suffering through a centuries-long winter caused by meteor impact. Do you ever see the stars or are the clouds always in the way? And I assume there's no large animal or marine life to speak of?" A few workers nodded. "Died in the immediate aftermath, no doubt. And now, after a slight warming cycle caused by this world's slow axial variation, it's going to get a little colder. If my ship hadn't come by, I'd guess half of the people here would've starved to death in the next several years." A scowl appeared on her face again. "That First Officer didn't appear to have lacked for food."

"They get all they want," Francesa said. Alarmed faces turned her way, but she kept talking, long-held resentment causing the words to pour out of her. "Because they're worthy. Because the Captain says the Officers and Crew have to get priority in everything. Food. And houses. And coal for their heaters and the best clothing. And we have to serve them."

Captain Balestra looked at Francesa for a moment before speaking. "The Captain says this, does he?"

"Yes." Francesa felt something else swell up inside and blurted it out. "That's what the First Officer *claims*."

The silence in the room somehow conveyed shock. Captain Balestra gazed around, then focused back on Francesa. "That big building up the hill, the one with all the carving on it. Is that where the Officers live?"

Francesa nodded. "I work there."

"And you, and everyone here, lives in places like this?"

The old man's voice sounded ragged, as if the blasphemies being uttered were overwhelming him. "The Captain and His servants need places whose glory reflects His own glory, places where His works are seen—"

Captain Balestra slammed a palm onto the nearest table, causing everyone to jerk and the old man's words to cease as if they'd been cut off. "If you truly believe this Captain is some sort of deity then he wouldn't need anything from you to make him more glorious. As for his works, look around you! Every single one of you is a greater wonder and monument than any building could ever hope to be! Have you forgotten that?" She calmed herself, shaking her head. "It wouldn't be the first time, I guess. And it won't be the last, I'm sure."

Francesa's father was shaking his head as well. "I don't understand."

Captain Balestra nodded. "I'm sure it's hard for you all to grasp. Let's keep it simple. By rough estimate, I can take about three quarters of the population here back to civilization. Maybe a little more. As captain of the *Bellegrange* I am required to make the decision as to who goes and who stays. I need you to tell me everything that might help me make those decisions." She smiled down at Francesa. "This one at least isn't afraid to speak truth to power. And she doesn't seem upset to see me."

Francesa couldn't help smiling back. "Your arrival meant the Watch forgot to give me the two lashes Officer Varasan ordered this morning."

"Lashes?" Captain Balestra's smile slowly went away and she looked at Francesa's father, who nodded.

"For breaking rules," he explained.

"I see." Captain Balestra's voice seemed colder than the wind outside. "Do the Officers and Crew ever get lashes?"

"No." Francesa's father spat out his reply. "Everything they do is what the Captain orders, they say. So they can't break any rule or regulation unless the Captain has told them to do so. They can't be lashed for being obedient to the Captain, can they?"

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"No, of course not," Captain Balestra agreed in a tone which belied her words. "I need some representatives to talk to. Five of you. You're one," she announced, pointing to Francesa's father. "The rest of you pick four more and make it quick. I have a lot more questions I need answered."

Her father turned to Francesa. "Go home. Tell your mother what's happening. She had to stay with your brother. All of you wait there for me."

"But—" Francesa started to argue.

The woman from the ship held up one hand to silence her. "This is your father? Listen to him. Captain's orders," she added dryly.

Francesa was out the door before she realized the lady captain might have been making a joke with her last statement.

Despite her excitement, once Francesa had described events to her mother and given the half-roll to her brother the fatigue of the day began overwhelming her. She wedged herself in an upright sitting position, determined to stay awake until her father got home, somehow sure he would be home, but at some point simply passed out from weariness.

She was awakened by a familiar hand on her shoulder. "Come," her father urged. Francesa blinked, trying to come fully awake, barely making out in the dimness of the room her mother already standing and holding her brother. "Your cloak. Anything you don't want to leave. Get it quickly."

Francesa wobbled to her feet, hesitated, then pulled her old ragged doll from the thin blanket that served as her bed. She swept on the cloak, then looked at her father, unable to read his expression in the dark. "Where are we going?"

"You'll see." Her father hustled them out and they began hastening up the slope. As they went, other workers and families joined them, until they were part of a column of people.

As they entered the courtyard Francesa gasped to see members of the Watch sprawled around the edge of the space. Her father made a shushing noise. "Don't worry. Captain Balestra said she would put them to sleep. They haven't been harmed."

Francesa kept staring at the Watch members' bodies as they walked on, wanting to see the movements that would mark them as sleeping and not dead. When she finally felt sure of that and looked forward again, the star craft loomed over them. Her mind suddenly numb, Francesa kept walking, following her mother into the rectangle she'd seen earlier, stepping over the high edge and into a room where colored lights winked at points on one of the walls just as the polished stones did on the altar in the Bridge.

Her father said something to her mother, urging her onward through another, smaller opening, then took Francesa's arm. "The lady wants me here. You should stay as well."

Francesa came along as her father led her to the side of the room, where Captain Balestra stood watching the stream of workers enter. Balestra acknowledged their presence with a smile to Francesa and a nod to her father, then went back to watching, occasionally directing Francesa's father to keep the column of people moving as briskly as possible.

The line of workers finally stopped as more than a dozen men and women Francesa knew as friends of her father came in. "That's everyone," one announced.

"You're certain?" Captain Balestra questioned, then frowned at something in her hand. "Ship systems logged a number coming aboard that equals the totals given in the census data we were provided."

"We never lied to the census," Francesa's father assured her.

"And my ship systems are reporting no signs of human life down hill from this location. Good. We can take twenty more, if their mass averages the same as

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your people."

"Watch member Yeli is a good man," one of the others offered.

Francesa's father nodded. "He's not like the others. And Watch member Tenal has a good woman for a wife. For her sake, he and his family could come."

"Fair enough. I need them and anyone else, up to twenty bodies, as fast as possible if they're to come at all," Captain Balestra directed. "Can you bring them here without rousing the rest?"

"I don't know." Francesa's father hesitated. "If the wrong people are awake . . ."

Instead of directly replying, Captain Balestra seemed to mumble something to herself for a moment. "I've used my lander's security systems to knock out everyone uphill from this spot. Take enough people to drag your friends. Now get going. Fast. And remember: only twenty."

Francesa's father pushed her against the wall with a gesture to stay as he rushed away with the others. Francesa stood there, rigid, still unable to grasp what was happening.

Captain Balestra murmured some more to herself as if she were talking to someone else, then smiled at Francesa. "I see you brought a friend."

Francesa stared down at the doll clutched in one hand, feeling heat in her face, and shoved the doll behind her. "I'm not . . . that is . . ."

"Nothing to be ashamed of, girl. We all need things that bring us comfort." Balestra stared out the opening at the world beyond. "Especially in places like this. It's not a bad thing, unless what brings you comfort comes at the cost of other people. You hang on to that friend of yours, so you never forget this place and why you and your family are leaving it while others must stay."

Francesa gazed up at her. "Why are *we* leaving? I thought—"

"You're leaving because you were still following the survival rules to the best of your ability. That's the justification I used. Those who tried to change those rules to benefit themselves, or because they thought themselves better than you, won't be coming."

Francesa was still thinking about that when her father returned with the others, dragging or carrying unconscious bodies with them. "Twenty-one," her father gasped as he entered, three children in his arms. "There was another child—"

Captain Balestra raised that commanding hand, frowning. "Wait." She paused, as if listening. "The children are small enough. We can take twenty-one. Now, get back from the hatch. The opening, that is."

Everyone crowded away, then the walls around the opening flowed together and sealed into a solid surface. Captain Balestra murmured to herself some more, then looked up at the workers around her. "We're lifting. Don't worry. You won't feel it. It'll take about an hour to reach the *Bellegrange*. Accommodations will be tight, and food rationed, but we should be okay until we reach port and the Sanctuary people can take charge of you."

Francesa's father laughed. "We're accustomed to small homes and little food. But hope is something we'll have to get used to." He glanced at Francesa, showing surprise at her somber expression. "What's the matter? Surely you're not sorry to leave."

"No," Francesa protested. "It's just . . . what will they be thinking? The Officers and Crew, who were so sure they would be taken up. Instead, they're the ones left behind."

Captain Balestra gave her a grim smile. "You've got a good heart to still care about that. I left them what supplies and survival equipment I could spare, and I left them a message to think about. I told them I had an obligation to take those most in need, an obligation they should understand since the writings they revered urged that behavior. I told them those left would have to work

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hard to survive the coming colder period, but that since they'd proven very good at looking out for their own interests they should be well suited for the task. And I told them that anyone who believes in a powerful divinity who rules them perhaps shouldn't go around making decisions for that divinity, such as who is worthy and who is not."

Francesa nodded slowly, thinking of how hard life would be for those remaining behind. "But they followed the writings. You told us the writings said good things."

Balestra nodded as well. "The writings, the survival rules, do say many good things. If the so-called chosen ones had spent more time and effort actually following the letter and spirit of those rules, and less time and effort oppressing those who read the rules differently, I would've had a much harder time choosing who to leave."

Francesa's father stared downward. "So, they *were* judged."

"I guess so." Balestra shrugged. "But then, sooner or later we all are, aren't we? The important thing to remember is that we never get to judge ourselves. Come on, girl. I want to show you the stars." ■

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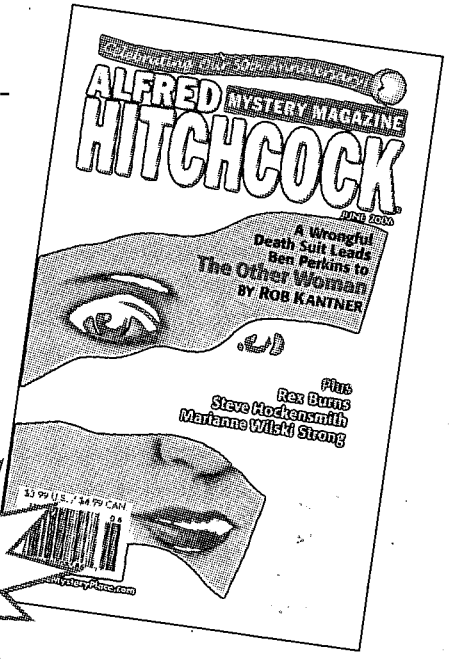

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PREPARING FOR THE DARK AGE

The common aphorism notwithstanding, ignorance is not bliss. True, if your beloved is unfaithful, the longer you remain in the dark about it then the longer you may remain in a state of emotional satisfaction, "blissfully unaware" as they say. But when the infidelity is discovered, typically one laments that blissful period with a cry of, "How could I have been so stupid?"

Yet stupidity isn't usually the problem—it's ignorance—in this case, ignorance of what the "signs of infidelity" meant. And it's easy to be ignorant. It can go undiscovered until, like an upthrusted-section of sidewalk, you discover it as you're falling on your face.

No fan of ignorance myself, I've found that it isn't easy to even *know* what you're ignorant about, let alone ascertain the subtle gradations of that ignorance. So when I get a unique opportunity to become a little less ignorant about something, I take it. This happened recently on a flight home from California.

It was just after Valentine's Day this year, during the stretch of bad weather that struck the upper Midwest and East Coast at that time. Though my flight from LAX to Chicago had been delayed by several hours, my connection to Grand Rapids had also been delayed. I was pleased that I'd still made it in time. When I finally boarded my flight, it turned out that it would still be quite some time before it was able to take off—traffic was severely backed up. Realizing that all I thought I knew about air traffic control had come from TV and movies, I took advantage of the headsets supplied by the airline and listened in on channel nine to the radio chatter between the tower and the planes.

If you want to witness air transportation professionals earning their pay, the time to do it is during stormy weather at one of the world's busiest airports. Particularly when everyone is itching to get out and ain't nobody goin' nowhere until the weather clears up (even if that weather is a thousand miles away). To my weary ears, it sounded something like this: *"8247, pull up to Zebra 21. UA-349, roll out of Charlie Five. 1256, pull up to the pad short of Tango 12, and wait until you hear back from me." "Tower, what's the latest on the weather in Boston?" "Thunderstorms." "Detroit?" "Freezing rain. 821, hold there until the Jumbo rolls past, then cross the bridge."* This kind of talk, rapid-fire every word of it, went on for hours.

While I was using the headphones, my fellow passengers were getting more and more impatient. The guy next to me said, "There is no reason for us to have to wait this long!" "Yeah!" someone seconded.

But I knew better. *Sure there's a reason. There are twenty planes in front of us. Some of them are going to have bad weather move in at their destination before they get up to the runway. We can't just roll over them.*

Being "in the loop" via the headset

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made me much more patient than I would have been otherwise. Had I not put on the headphones, I would have been bitching like the other passengers. But I was appalled by the *depth* of my prior ignorance about what the conditions were like for the pilots and the tower crew. Despite having flown across the country many times, as familiar as I'd thought I'd become with airplanes and airports, I'd had no grasp of what the people in charge of getting me safely from here to there have to deal with.

In the end, the freezing rain moved out of Grand Rapids and the flight home was essentially uneventful. The bitching came to an end, replaced by cheering when we landed. Those cheering the loudest were still blissfully unaware of the details of quite why it was we landed six hours late.

I'm depressed.

I told you the plane story so I could discuss the discouraging nature of a particular brand of ignorance that currently infects the USA. I bring it up here in *Analog* because you guys appreciate the value of being prepared for the future. But the USA is a country that is not at all ready for the future, nor preparing for it.

It isn't just a matter of ignorance. As I illustrated above, any intelligent person is aware that there is a lot of which he's ignorant. And there have always been, and always will be, people way too ignorant for their own, or anyone else's, good.

But what happens when ignorance becomes acceptable?

I'm not talking about this in the simple, self-esteem enhancing way. "There, there, Johnny, it's okay even if you can't find the Pacific Ocean on the globe." The problem is that ignorance is becoming acceptable out of a general *ignorance* of what constitutes ignorance. What is just as bad, the primary tool for eradicating ignorance, that being literacy, is also on the decline.

My depression started last December. My local paper, *The Grand Rapids Press*, reprinted an article from the *Baltimore Sun* about the results of a recent literacy study done in the US. The opening sentence reads, "More Americans are getting college degrees than a decade ago, but skills in reading and analyzing data among the well educated have dropped significantly . . ." Accompanying the article is a graph showing that only 13% of Americans are at a "proficient" prose literacy level. Unfortunately, all proficient means in this context is that they can do "complex activities such as comparing viewpoints in two different editorials." It doesn't say whether or not they can also contrast and *evaluate* those editorials.

Yet 100% of those people get to vote (not, fortunately, that they all will).

A piece by Ben Feller, education writer for the AP, in a web article from January 19, 2006, discussed the same study. He pointed out that, "The results cut across three types of literacy: analyzing news stories and other prose, understanding documents and having math skills needed for checkbooks or restaurant tips." Most dispiriting to me, however, is this: "The survey examined college and university students nearing the end of their degree programs. The students did the worst on matters involving math, according to the study."

This doesn't upset me because they did poorly in math—I used to teach math and I expect those skills to be at the bottom. The upset came with another Ben Feller piece that appeared in the *Press* on February 19, 2006. The title was "What Crisis? Parents, pupils content with math, science." These two quotes pretty well sum up the article: "(B)oth topics are important, but 'most parents are saying you're better off going to school for something there's a big need for.'" Also: "Nationwide, a new poll shows, most parents are content with the science and math education their children get—a starkly different

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view than that held by national leaders." Along with the article was a sidebar (attributed to "Public Agenda") in which surveys show: "Most parents believe their children are taking enough math and science, while 45 percent of students feel a career in these subjects would make them unhappy."

In other words, despite the critical need for better math and science education, parents disagree. They agree that math and science are important, but think their kids are better off pursuing "something there's a big need for." Don't they get it? The reason there is a concern about inadequate math/science education is *because* there is a "big need for" people proficient in those subjects. Despite the current state of national despair over low math ability, parents say the problem isn't in their district—*their* kids take enough math and science. (Right. And a survey of my fellow passengers would have concluded there was no reason the plane couldn't take off.)

Alarmed and disheartened as I was by these articles, what finally spurred me to write this one was an opinion piece by Richard Cohen of the *Washington Post* writers group. It appeared in the February 18 issue of the *Press* under the title, "Life Without Algebra." Therein, Cohen tells us of the plight of Gabriela, a student who dropped out of high school in LA because she couldn't pass algebra despite being in her seventh try. He is concerned that, since LA began requiring the passing of a year of algebra and a year of geometry in order to graduate, young lives are being ruined. He says in his column (without citing a source) that more kids drop out because of algebra than any other subject. You almost get the feeling from him that, if it weren't for algebra, these dropouts would all be on the honor roll, passing SATs and getting ready for college.

Cohen admits his bias on the matter. He failed algebra himself, and only passed it the second time via "divine intervention." The bulk of his column is aimed at Gabriela, telling her that there is life after algebra, and that she'll never need to know it, and that she'll never miss it. Such has been his experience.

Unfortunately, he doesn't stop there. He goes on to tell Gabriela that algebra doesn't teach reasoning, but that writing "is the highest form of reasoning." His proof of this assertion "is all the people in my high school who were whizzes at math but did not know a thing about history and could not write a readable English sentence." He names no names nor explains how it is he, as a high school student, would have known how well the math whizzes were doing in History or English composition.

Being able to both write and do algebra, I can't help but notice the lack of the quantitative in Cohen's thinking. How *many* whizzes are you talking about, Mr. Cohen? Is it a representative sample? Do you know what a representative sample is? I know you don't know what a sampling error of plus or minus 3 percentage points means (the error cited in the survey discussed above) because in your column you said you can't do percentages.

Indeed, Cohen has missed the one thing that algebra and mathematics teach better than any other subject: that being that there are right answers and there are wrong answers, and how you *feel* about those answers will never, ever, make a difference to what they are. Regardless of how much better your life would be if the answer were different, or how certain you are that the answer really should be something other than what it is, the right answers and the wrong ones will remain just that.

Like I said, I'm depressed. As readers of this magazine know as well or better than most, a twenty-first-century civilization not only cannot advance without adequate literacy, both verbal and mathematical—it cannot survive. A civilization not preparing for the future is sure-

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ly preparing for a Dark Age. I see a country full of my fellow plane passengers, certain of how things are and what should be done. Yet ignorant, and complacent in that ignorance, about how things really are, and about what really can, and should, be done.

Maybe I'm being too alarmist. Maybe my fellow passengers did understand things better than I'm giving them credit for. Maybe the parents who think their kids are already getting an adequate math education will decide they should check and make sure of it. Maybe Richard Cohen will learn how to use the quadratic equation. But I doubt it.

What do you guys think? ■

IN TIMES TO COME

Robert J. Sawyer, as you've probably noticed by now, has a way of taking familiar ideas, looking at them from new angles and in greater depth than almost anybody before him, and tying them together to create extraordinarily fresh and thought-provoking stories. The latest example is his novel *Rollback*, which we'll be serializing in four parts beginning in our next issue (October). We've all seen lots of stories about rejuvenation and lots of stories about the search for extraterrestrial intelligence, but how often have you thought about how the two might be connected? Well, consider these questions: Who could maintain interest in a very long, slow conversation long enough to go anywhere with it? What would be worth talking about under such conditions? If rejuvenation is very, very expensive, as it probably will be at least initially, what would motivate anybody to pay for it? What would it really be like—and what if it doesn't work the same for everybody? Sawyer's answers to those, and the many others they stir up, will guarantee you a thoroughly engaging story, and acquaintance with some of the most memorable people you'll ever meet.

Richard A. Lovett's fact article examines what we can learn from the devastating Sumatran earthquakes (you may know them better from their side effects, called tsunamis) of 2004-5. He'll also have a story in the issue, as will such notables as Ben Bova (a new tale of Sam Gunn) and Robert J. Howe (a quietly touching story of a different kind of alien contact, in which the aliens used to be us).

All of which makes for a solidly satisfying issue.

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Probably Murder

Michael F. Flynn

It was a dark and stormy night; and, sure, I know how that sounds; but so it was. Himself watched the door with no little favor, for such nights may be blessing or curse to the Irish Pub. Those who were out in it would seek to get in out of it (and perhaps warm their insides a little), but those already indoors would hesitate to go out for the wee drop.

This seemed a night for staying in. The stools around the oval bar held beside myself only Danny Mulrooney who snored on a stool nearby, to the displeasure of the cash register. For myself, I could hoist Guinness with the best of them, but it was not in me to compensate for all those absent. Beside, I was awaiting only The O Neill, who had tickets to the game. A basketball game at the University might be called many things, but "on account of rain" is not among them. It was no fit night for man nor beast, as the poet once said; but roundball fans fall somewhere in between.

When the door did fly open, however, it was Sam Hourani who came in, and a bit o' the weather with him. "Something dry," he told Himself, shaking the rain from his overcoat and hanging it in the corner. "A martini, but just let it peek at the vermouth."

"What brings you by, Sam," Himself asked, "on a night like this?"

"Business," said Sam, studying the drink placed before him from several angles.

Now, Sam's business was detective of homicide, so the announcement startled us some and we looked about for a possible corpse, considering, then rejecting, Danny.

The detective lifted his drink; but, though his expression had promised a swift end to it, he only sipped a little before replacing it. "I know a man," he announced, "who probably committed

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murder."

"Ah," said Himself, "but you're not certain. No *corpus delecti*?"

"Oh, there's corpus enough, poor woman, and it's her husband that did it."

"Did he now? Ah, those are the cruelest sort. How did he do it?"

"She fell down the cellar steps and broke her neck."

"And he pushed her!" I said.

Sam shook his head. "He wasn't in the house at the time."

"What'd he do, then, grease the steps?"

"No, I said he *probably* committed murder. He was a statistician. So, he insisted she do the laundry and the laundry was in the basement."

Himself crossed his arms. "This will make sense some day, I'm thinking."

"Death by falls is the second greatest cause of death. The probability is . . ." Sam pulled a notebook from his breast pocket. ". . . is 56.4908 deaths per million per year." He looked up. "That's an aggregate figure, of course. For each trip up or down, it's even smaller. But every time he made her do it, it was one more opportunity for a fall."

"But," protested Himself, "that hardly makes the poor felly a killer!"

"Not by itself. But he also insisted that *he* drive the car, which meant that *she* always sat in the right front seat, where the risk is greater. No passenger-side air bag, either. He took her swimming every week, though he never went in himself, and death by drowning is 14.9236 per million. He insisted she bathe, not shower. That's 1.2439. He encouraged her to smoke. *He'd* broken the habit, but he told her it made her look sexy and discouraged her sporadic efforts to quit."

The lights blinked and a clap of thunder shook the windows, causing us all to flinch. Even Danny stirred and almost raised his head from the counter top. Detective Hourani smiled a little. "He would have found some excuse to send her on an errand tonight. Death in cataclysmic storms is 0.3506 and lightning is 0.2375 per million."

"Well," I said, "that may be abusive behavior, but how can you say he *murdered* her?"

Sam sipped a little more from his martini. "I told you. He's a statistician; works as an insurance actuary, and he knew every single one of those risks, medical and casualty. Kept them in a notebook at home, which is where I got these . . ." He waved his notebook. "It works this way, you see . . ." He flipped a page. "The survival rate is one minus the risk. To find the chance of surviving *all* the risks, you multiply the survival rates."

"So if there are two things that can kill you," Himself wondered aloud, "say, 10% of the time; then the chance of surviving both is point-nine times point-nine, or 81%."

Sam nodded. "That's it."

"So, then," said Himself. "This felly—"

"—exposed his wife to as many risk factors as he could, every day. Sure thing, she'd probably survive *any one* of them; but she'd probably not survive *all* of them. That'd be 0.9999435092 times 0.9999850764 times 0.9999996494 and on and on. *Multiple* trips up and down the stairs with a laundry basket; multiple trips in the car; two or three packs a day of cigarettes . . . Chances of long-term survival dropped exponentially. Oh, the guy killed her, all right. He was patient. He worked the numbers. He saw me reading his notebook and he smirked at me, the damned bastard. That's when I knew. That smirk. He couldn't just be clever. He had to know that I knew how clever he was."

Himself glowered at the wickedness of men. "D'ye think you'll ever get him?"

Sam drank the rest of his martini and placed the glass on the bar. He smiled coldly.

"Probably." ■

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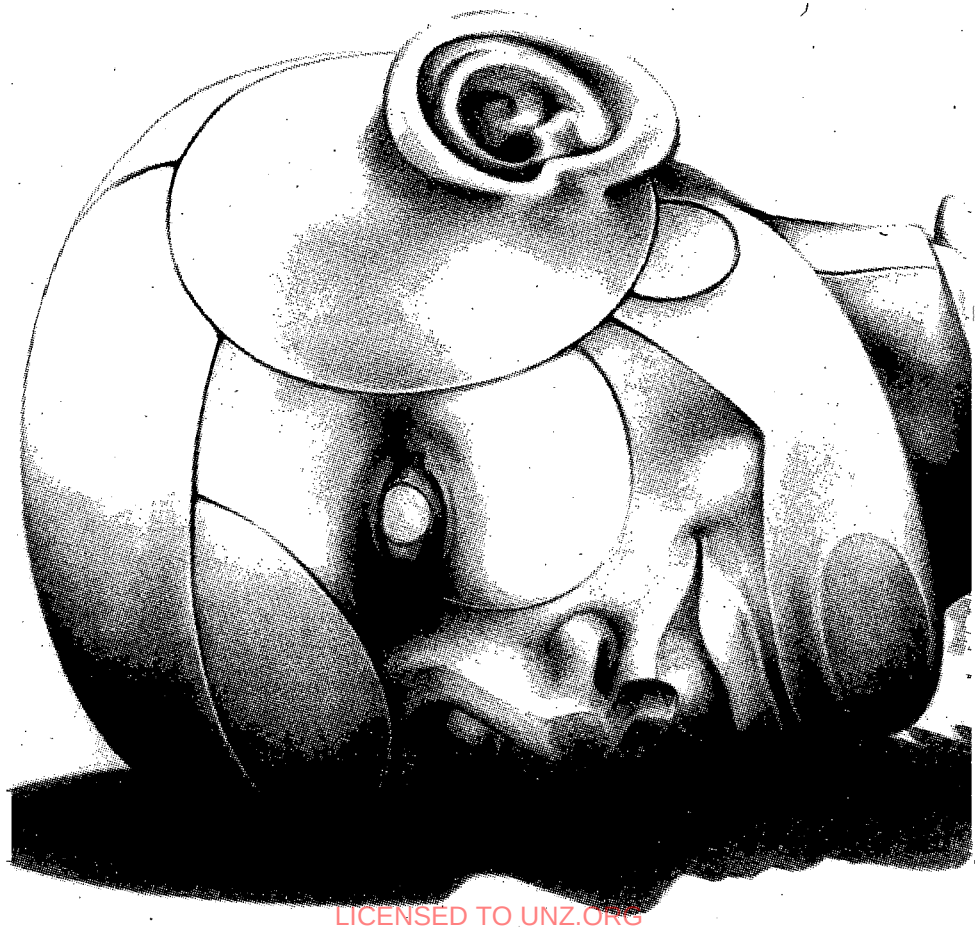
The tendency to forget why you came into a room may increase with age, but few have experienced it quite like this!

A MILLION YEARS AND COUNTING

Rajnar Vajra



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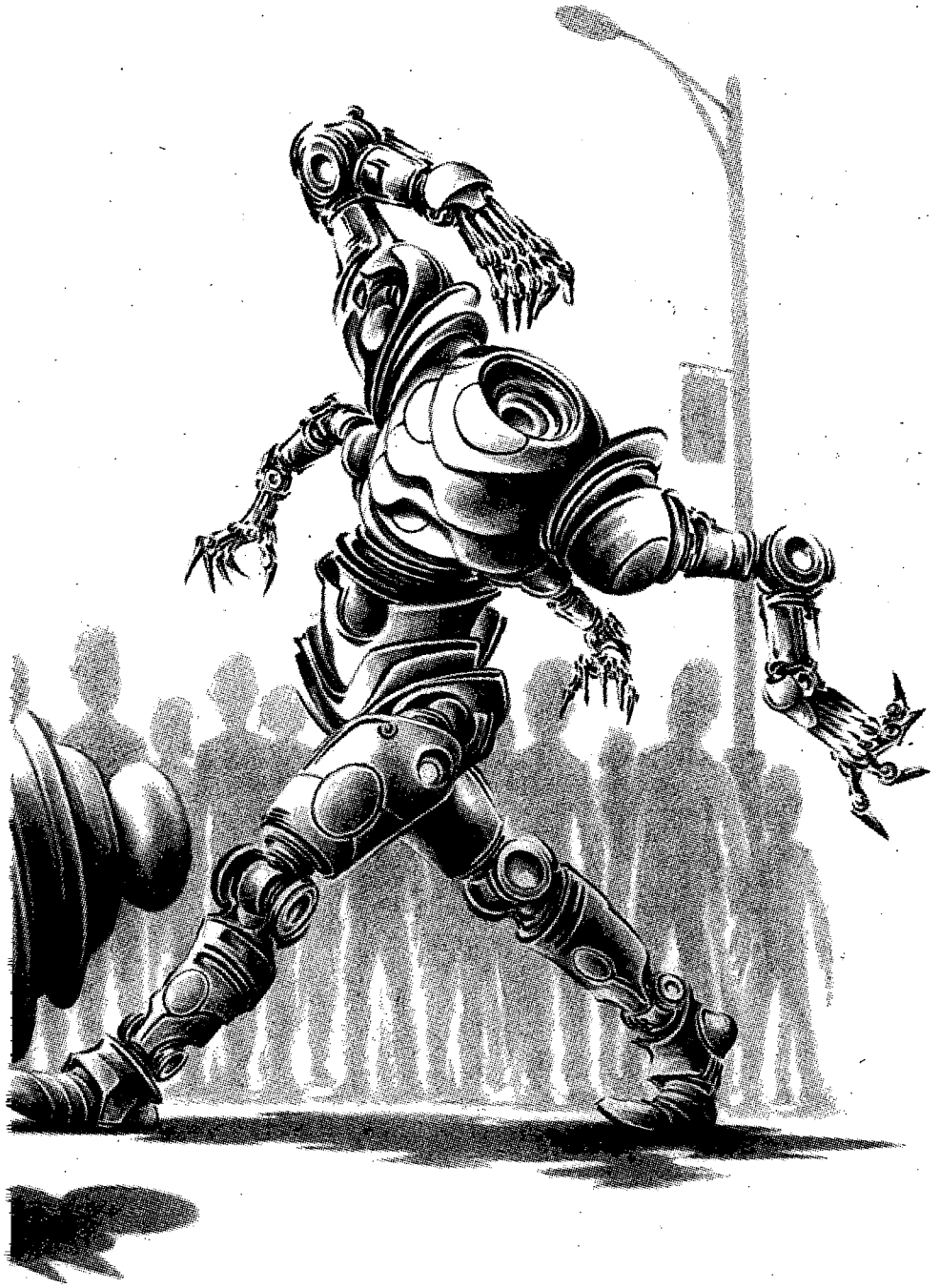

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I was walking across Lincoln Center's Josie Robertson Plaza the first time my head fell off.

Something inside my neck clicked, my body froze in place, the world and sky circled each other, and my cranium clanged against hard tiles. Twice. The second due to a minor bounce.

Strange.

If my head were as spherical as it had been when I'd been found, and no one was thoughtful enough to put out a blocking foot, it might've rolled all the way to 9th Avenue—surely a world record of some kind. Instead, my extruded nose, chin, ears, and imitation cheekbones insured a wobbling course, which made it tricky to calculate where my head would come to rest.

The resulting estimate was worrisome. My need had summoned protocols for handling such a crisis—which was strange in itself since the event seemed so improbable—but no assurance these protocols would work with my cranium between nine and ten meters from my body. Further calculations started me extending my nose and expanding my ears.

The Metropolitan Opera House, some gushing waters, Avery Fisher Hall, and the New York State Theater revolved around me at creative angles and I fancied the scene would be dramatic as viewed from above: an oversized humanoid noggin in tasteful sheens of gold and silver careening over the tiled spider-web surrounding Revson Fountain.

I hoped someone was enjoying my situation; it added no luster to *my* day. And certainly, I had no shortage of audience. At ten to eight on a cloudless morning in early March, Lincoln Center wasn't crowded, but it was hardly uninhabited. Dozens of voices gasped, yelled, muttered, or swore. After the initial surprise, the most popular phrase was "Moon Robot," including one youngster's screech: "Hey, Dad! That's the Moon Robot! How come its head popped off?" I knew the Plaza was crackling, even more than usual, with patterned microwaves doubtless image-messaging my predicament.

If anyone, I thought, would manually re-place my crown, the gesture would be deeply appreciated. I blinked a similar message ten times in Morse code but with humble expectations. How many people in this decade of megapatches and exoplanetary enclaves on Mars and Titan have even heard of Samuel Morse or Alfred Vail? I worked on that problem until it proved unsolvable with my current information.

"Can't be Dan the Can, JJ," a man's voice announced. "Probably one of those Toshiba-Disney knockoffs made to look like Disney characters. But with a bad weld. See that face? Dan doesn't have Pinocchio's nose or Dumbo's ears. Besides, something that's lasted a million years wouldn't just fall apart."

I had the perfect retort at hand, but no voice available. Or hand, for that matter. And by the time I was reassembled, the opportunity would surely be long passed. Such, I have noticed, is life—or in my case, existence.

An interesting question arose. Although my primary sense organs are attached to my cranium and therefore my identity feels similarly attached, no one on Earth knew if whatever I used for a brain was in my head or placed, say, in my left leg. If so, was I technically out of my mind right now? Or was it the other way round?

With a little luck and a lot of nose, my head stopped spinning with one eye adequately positioned to see the rest of me—a convenient arrangement since I could only migrate my eyes a few inches and without visual guidance, I'd have no way to know if someone were standing in my body's way. The thought of trampling little JJ was upsetting.

Perhaps Professor Norhaart is right about me having a subconscious because the exact telemetric etiquette

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was already waiting for me as I reached for it. While I pondered what *kind* of signal my body could receive since most forms of electromagnetic radiation bounce off me, the bulky thing stirred, the crowd gasped, and a headless giant lurched across the Plaza. Couldn't feel a thing until, a moment later, my head clicked back into place with enough authority to almost convince me the join was permanent.

I shrank my expanded features and bowed to my audience—taking due care to keep my skull balanced!—as if I'd completed a circus trick. Then I hurried toward 9th Avenue with an eye out, figuratively this time, for the nearest full-size taxi. I'd only recently learned to fold myself to fit into a cab's back seat.

A ride appeared quickly, but the wait while New York's Energy Authority got the gyros up to speed while feeding off my cred-disk seemed to last as long as my stay on the Moon. Subjectively, much longer, since I couldn't actually remember my Moon visit. Embarrassment made me anxious to leave, and my relatively newfound ability—only two weeks old—to *feel* embarrassment made me more anxious. And I'd already been plenty anxious before my decapitation.

Boiling it down, I had to talk to Jon Norhaart immediately. Obviously, something within me was going horribly wrong.

On the bright side, I now grasped a concept that had eluded me for years: irony. I'd come to Lincoln Center this morning because it's so infused with art and culture, which inspires me when I face particularly difficult problems. And those problems had made me determined to avoid one particular person today: Jon Norhaart.

"Your head came off? Just by itself?" These questions sounded as if I were talking to myself because here was the model I'd used for my voice and speech mannerisms.

I ran an image comparison series to confirm that I'd never seen Professor Jon No-Middle-Name Norhaart, my mentor and friend, wearing such a surprised expression. His raised eyebrows quilted his normally baby-smooth forehead, which was higher than male norm due to innate physiology and encroaching baldness. His blond-and-gray moustache made a fuzzy lintel shadowing an open mouth. He didn't wait for my response but leapt out from behind his desk, scrutinized my neck from eyelash-tickling range, and gently palpated the area with both hands.

I thought it best not to nod. "Just by itself."

"Huh. No structural flaws I can see or feel."

Indeed, in the bathroom mirror down the hall, my neck had appeared perfect. I *had* noticed, for the first time, how much my face resembled Jack Haley's Tin Man from *The Wizard of Oz*.

"You'd have mentioned it, I'm sure," Jon's voice was wry, "if this had happened before?"

"I've no memory of such an event."

He rubbed his eyes and leaned back against his desk, not quite sitting. When he looked up at me, his autocontacts visibly adjusted to the new viewing distance and it crossed my mind that human technology was already on track to produce something like me. But not soon. The Toshiba-Disney household robots based on me were nearly useless toys for the ultra-wealthy.

"Daniel," he asked, "have you any idea how peculiar this is?"

"Yes, but no. For me, reality is always full of surprises. I found this one more shameful than strange."

"Shameful?"

"The visual symbolism was disturbing. Your culture has so many telling phrases. Having your head on straight, a good head on your shoulders, losing your—"

"Dan." He waved a hand as if discouraging flies. "Do you remember being in

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the Army's custody?"

"Impressions only. I couldn't understand what was happening around me."

He nodded, frowning. "For more than two decades, scientists tried like hell to tear you apart."

I warped the corners of my mouth to make my own frown. "I don't recall that although I've dreamed about being . . . tugged at. And something about shears, perhaps. I know they didn't succeed."

"Right, and believe me, they tried everything from pry bars to acetylene torches. Everything short of burst-lasers and micro-nukes, which wouldn't have left much to study."

"Ah."

"You're made of tough stuff, whatever it is."

The thought of blowtorch fire on my skin, which I keep sensitive enough to detect a crawling ant, made me feel weak at the knee joints. Maybe I don't feel pain as humans do, but too much sensation is highly unpleasant. I lowered myself into the armless chair my mentor kept here for my use. "What were they looking for?"

"Everything. A clue as to who or what built you. How a material usually harder than steel could so quickly mold itself into varying shapes. Most of all, maybe, the nature of your power supply. From analysis of regolithic dust, we know you were in that cave for *at least* a million years before we found you. And here you are. Still ticking."

This story was old news to me, but I was hearing it differently today. "Doesn't twenty years seem a long time to keep me isolated? Scientists outside the military must've resented being shut out."

He frowned again and a fingertip wiggled on the desk. "I'm getting worried about you, Dan. You don't sound like yourself. Uh, I mean—"

"I know what you mean. But you haven't answered my question."

"Right." He sighed. "There was another factor. The government was afraid you might be a—well, a Trojan horse of some sort." His face flushed a bit.

I took a millisecond to reread two stored versions of the *Iliad*, one in Greek. "Why?"

"Why would aliens abandon a piece of such advanced technology on the Moon for eons? And why leave an intermittent radio beacon to advertise your presence? So they could find you again? Or were they planning for someone like us to find you? See what I mean? It's the government's job to consider all possible security risks."

"Still, twenty years?"

"Does seem extreme. But try to imagine being responsible for the safety of the entire human race."

I tried. "Wouldn't it have been more sensible to leave me on the Moon?"

He shrugged. "And throw away a priceless opportunity? Quite a decision! I'm just glad the Army finally decided you were harmless. Hang on a minute."

He tapped one side of his head: tap, pause, tap-tap-tap; then his throat muscles began to twitch slightly and likewise his lips. I felt my usual frustration at being opaque to microwaves and incapable of using a telicell system myself. And I was upset with other limitations. Evidently, some people can throat-read, but despite superhuman vision, the skill was beyond me.

"Sorry to interrupt our conversation, Dan. I wanted the physics lab to send up a pair of eye-queues if they had any free. Wanted to see if your neck was radiating anything in the UV or infrared range."

"Any luck?"

"One pair of six-ways available."

"Why don't I go downstairs and pick them up myself?"

He grinned. "You just want an excuse to bask in the Guru's radiance. Sorry, his assistant's already on the way."

"That's the story of my non-life. Anyway, what do you expect to see?"

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"Always a mistake to expect." He chewed his moustache and twisted the CPU he was wearing around his right pinky. "While we're waiting—aside from your head coming loose, anything else unusual happen to you lately? Done anything new and different?"

Uh-oh. "We received quite a collection of shards at the museum on Tuesday," I said to delay the inevitable. "One urn came in 5,422 pieces! Can't wait to put it together."

"You must be a godsend to archeology. But I meant *unusual*."

I felt myself wanting to shift in the chair like a nervous child, but forced myself into stillness. "I rescued a toddler yesterday. Never done that before."

"What?"

"I may have saved a little girl's life."

One of his eyes gleamed a brighter blue in a stray shaft of sunlight and my conscience turned it into a gleam of suspicion. But all he asked was, "What happened?"

Given any assurance my head would stay put, I would've attempted a new wrinkle on my latest skills and imitated his shrug from fifty-six seconds ago. Humans have such expressive gestures. "I suppose the mother got distracted. Her child made it partway across 5th and one truck driver didn't see her. Someone caught the event on celivision and the upload made it on to last night's webcasts. Now I'm famous," I added, trying out my grasp on irony.

Perhaps I needed a firmer grip because he didn't laugh. "I'll have to replay one of those 'casts—wasn't in the mood to watch the usual bad news last night. Huh. Good thing you were there and that you can move so fast when you want to. But why do I feel you're holding something back? Anything *else* new and different?"

The unknown lubricants in my mouth seemed to have dried up. I'd run out of decoys and seriously considered lying, but I'd never tried the technique and doubted I could pull it off. "Spent four hours last night with your daughter. Talking."

"Oh? Well, Linda always liked you."

"Not Linda. Alison."

"*Alison*!" His voice rose by a minor third as his jaw tightened. Now we didn't sound identical. "Since when do you know *Alison*?" His entire personality seemed to harden—emotional scar tissue, I thought, which wasn't at all my usual sort of thought. . . .

"Met her for the first time last night." I decided not to inform him she'd stayed at my apartment overnight and was likely still there.

"Really? What the hell did she want?"

"She wants you to forgive her."

He stared at me for a second. "Her judgment hasn't improved any. And, Daniel, this really isn't your business."

I reread twenty books on human psychology and learned nothing applicable. "She's pregnant."

It wasn't so much a bombshell as the explosion itself. His eyes widened, his lips tried to push past each other, and his jaw worked as if chewing. "What?"

"She's pregnant."

After a polite tap on the door, Todd White, the Guru's senior work-study assistant from the physics lab below, pushed into the room bearing a smile, a small box, and some bulky goggles. He took one look at my mentor's face, lost the smile, deposited his burdens on the desk, and left without saying a word. He had the right idea. I suppose working for the Guru might boost one's sensitivities.

"She needed someone," I said softly as the door closed behind him, "to speak with you. On her behalf."

Jon opened his mouth, but clacked it shut and shoved the goggles on his head as if to hide his eyes. As the lenses stared at me they changed color six times, constantly reflecting light like a tapetum lucidum.

He remained silent, not like him at all. I searched for protocols for this situation and came up empty.

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"I hadn't meant to upset you," I finally said.

"These damn lenses are filthy and everything's blurred. Got to clean them. Stay right there." He practically ran from the room, still wearing the goggles, and his hands shook.

I stared at the back of the picture he always kept on his desk. I'd seen it from the display side on six hundred and thirty-nine occasions and from this side almost daily for five years. It showed a slightly plump woman with brown hair and green eyes, smiling: the professor's dead wife.

As I'd learned last night, Danielle Norhaart had been killed six years ago when her car swerved off the road and into a tree. This wasn't her fault. She'd been in labor and had asked someone else to take her to the hospital. And because her due date had been nearly a month away, her husband had been at a conference out of state. So she'd asked her daughter Alison, who was pregnant herself, to drive.

She hadn't known about Alison's drug problem.

Walking to my apartment, I heard the honking from fifteen blocks away.

Four minutes later, the cause came into view and assorted shouting clarified the cause of the cause. Thanks to a dispute concerning right-of-way, two delivery trucks had gotten too jammed together for either to get clear without damaging city property. Then enough traffic had piled around them to force police officers to leave their vehicles to reach the epicenter. The truck drivers were standing in the street yelling at each other, cops were yelling at the truck drivers, and various people in stuck cars were just plain yelling and jabbing their horns.

I jumped over hoods and stomped on bumpers to get to the biggest truck. There, I lifted one end and carried it over a few feet, far enough to start the un-jamming process. All honking ceased. Instead of setting the truck down gently, I just let it fall. From within the van came crashes, bangs, thuds, and sad little tinkles.

Everyone stared. Perhaps they were as shocked as me that I'd performed my first deliberately rude act. Good and bad deeds for the day done, I resumed walking.

On paper, the lease on my four-room apartment is 350,000 dollars per year, somewhat over my budget since the university pays me about ten thousand, before withholding, for my part-time services. And the American Museum of Natural History only supplies another five.

I lived in luxury's lap gratis.

The owners of the high-priced high-rise, or rather their lawyers, had approached me at the museum, where I'd had an acting job, playing myself in a diorama of the lunar cave where I'd been found. Dan the Can, tourist magnet. This job had provided a small income and, more importantly, a place to stay during those hours I wasn't working with Professor Norhaart or harvesting the Guru's wisdom. But after three years, I'd felt a growing need for some privacy.

So when the lawyers offered me an apartment on the thirty-eighth floor, rent-free and all utilities paid, where windows revealed the intricacies of Manhattan rather than staring faces, I accepted. Apparently, the high-rise owners assumed my presence would generate continual publicity, which would attract more renters, which would allow them to boost rates.

Besides, at that point I'd found a more enjoyable way to earn money and it didn't involve being on display. The museum had received a shipment of *Albertosaurus* bones, mostly small fragments. After observing the staff paleontologists struggling to assemble pieces for an hour, I'd succumbed to temptation and begun pointing out which

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piece went where. This got me one job and led to a similar one in the university's Archeology department.

I don't eat or excrete or sleep—although I sometimes dream while awake—but money allows me to buy clothes, presents for my friends, books for myself, and lately, transportation. Also of late, I've enjoyed giving money to needy people on the street.

Today, my apartment held a very needy person, but money wasn't her problem.

"How'd it go?" Alison Norhaart demanded.

I'm a poor judge of human attractiveness, but Alison's features were unusually symmetrical. Her sandy hair was long and glossy, and her large eyes were even bluer than her father's. Still, her long addiction had burned fine wrinkles around her lips and turned the flesh near her eyes thin and fragile-looking. And her skin had a slightly grayish undertone, although maybe that was from anxiety. She'd gone through a successful rehab and was no longer using drugs. So she'd said and I believed her.

"I'm afraid it didn't go anywhere."

Her shoulders slumped. "But you told him, right?"

"About your pregnancy, yes. But he wouldn't talk to me about it or about you. Alison, you're not only asking a machine to deal with a tricky human problem, but an *alien* machine. If there's any way I could be less qualified to help you, it escapes me. I can't begin to understand the depth of his feelings or how to ease them."

"That's not—Daniel, I haven't told you . . . everything yet." She stopped and when she spoke again it was barely a whisper. "After I'd killed mom. And my unborn sister. I didn't want my own baby. Didn't want to raise a baby without mom. And the father would be no help. Didn't even know which asshole he was and it didn't matter; they were all losers like me."

She fell silent for twenty-eight seconds.

"Maybe I wanted dad to know my plan and stop me. Why else would I have told Linda?"

"What plan?"

"Abortion. I was nearly in my fourth month. Dad begged me. Said the baby and Linda and me were all he had left of mom. He promised to raise my baby *himself*, if I couldn't do it."

All this was beyond me, but it gave me a terrible feeling where humans keep their stomachs. Having no idea what to say, I said nothing.

"Daniel. I had that abortion. I think I was really trying to kill myself."

"I'm sorry." Why do people have to *suffer* so much? "I need to think about this. Maybe it can help me figure out how to reach your father."

She nodded, but kept watching me. To escape those eyes, I grabbed my remote, pushed the power button, and turned to the Light Emitting Plastic membrane on the east wall of my living room, which immediately lit up.

"My God," she said after a moment, "I'd assumed that was a virtual window, but it's a TV! I haven't seen a physical video monitor in a private home since I was a kid."

I turned back toward her. "CV doesn't work on me, Alison. Sorry, I didn't intend to sound upset about it. It's just that it's so easy to stream data into a human's visual cortex and auditory nerves. And with me, it seems to be impossible. I probably don't even *have* a visual cortex."

She wasn't listening. "Hey! Look what's on! That's you!"

I looked. She was right, but it wasn't any clip I might've expected. Neither my cranium out for a nice morning roll, nor the toddler-rescue from yesterday afternoon. While some commentator was happily commentating about how I'd been named after a robot character in an "obscure" novel by Isaac Asimov, Dan the Can was lifting a large truck by its rear bumper, scooting it over a yard or so, and letting the tail end drop. This

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shouldn't be online for hours yet. Some reporter had been following me.

I watched the replay, fascinated as usual at how strange I appear from the outside. Much larger than I imagine myself, and the extra pair of arms I keep minimized and pressed against my sides are still too noticeable. The effect is distressingly inhuman. . . .

My phone rang.

"What the hell was that?" Alison asked, eyes wide.

"A telephone. I need an external one of those, too."

The voice on the other end was Professor Norhaart's, which wasn't too surprising since only eleven people could reach me this way, but the synthesized phasing characteristics I heard were unique in my experience. I guessed he was applying the broad powers of his high-security megapatch through the Metropolitan Data Authority to connect two normally immiscible systems: my phone line and a DNA-encrypted telicell link. Such a call should be eavesdrop-proof and leave behind no trace, assuming the system lacked a category in which to note this freak event.

"Dan?" Even sub-vocalizing, he sounded out of breath. "Just caught the latest newscast and we've got a problem."

"What problem?"

"God knows we've tested you often enough and you've never shown strength like that before! What made you think you could lift a truck?"

"Never occurred to me I couldn't. But I shouldn't have put it down so roughly. Perhaps a letter of apology would—"

"Dan! What were we talking about just half an hour ago? The military only released you because they decided you were *harmless*. Do you hear me? I'm watching your little demo on a loop right now and not too many people seeing this would describe you as harmless. Even to me you look . . . violent. The government will be coming after you, and soon."

"Why? I was just trying to help!"

"I know you were, but you were moving so fast . . . even CNN is saying you threw that truck out of spite."

I stepped to the window and glanced downwards. Traffic on the street below was unusually slow and dwindling. The same was true of Lexington, the one avenue visible from this window. "Why don't I just tell the government I'm harmless?"

He sighed. "You think they could afford to take *your* word? Look, do you want the army to lock you up again?"

"No!" I was astonished at how much the idea disturbed me. "What should I do?" I enhanced my hearing and caught an approaching chop of helicopter blades.

"Get out of there. I mean *fast*. Meet me at—no, they'll be looking for you here and at my house. Damn. Meet me at the Guru's apartment." He supplied the address, knowing I'd memorized the entire New York City map. "You seem to be changing and this is no time for us to lose contact."

"Professor. Alison's here, standing right next to me. And it might be coincidental, but a helicopter's landing on the roof."

His hesitation was surprisingly brief. "She's in danger just being with you. Tell her to leave."

I turned to her. "Your father believes I'm in trouble with the authorities and thinks you would be safer elsewhere. I'm meeting him at Professor Besden's home."

She grabbed my upper left arm. "Then I have to go with you."

"Hell, no!" yelled the voice on the phone. "I heard that! She can't be anywhere *near* you. I don't know what the army will have in mind, but Dan, they might even try to destroy you, to stay on the safe side."

"*Destroy* me?"

"You're tough as hell, but I doubt even you could survive a high-powered

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burst-laser."

"You've convinced me. I'm out the door. We'll figure out our next move when I see you." I hung up without saying goodbye.

"You can't go with me," I said to my guest, gently detaching my arm. "Your father's right."

"I'll risk it. I may never have a better chance to show him how—how much he means to me."

I studied her for a moment. "Do you want to risk your unborn child?"

Her face paled as if I'd slapped her. "No. I hadn't—"

"Hold on." A second helicopter was approaching and a third wasn't far behind. I assessed the thuds of heavy boots already running on the rooftop thirty-four stories above us. At least twenty soldiers were on their way—heavily armed troops judging from some faint rattles. Even the footsteps sounded aggressive. If Alison left now, she might not be safe anywhere in the building even away from me. I've read that in combat situations, soldiers have been known to fire at any sudden movement.

"Changed my mind," I admitted. "Maybe there's a way we can protect each other." Three weeks ago I'd seen an old cartoon featuring robots, which had given me a crash-course in applied topology. I could do more than just fit into cabs. . . .

"What do you mean?"

"You'll see. Wait right there." Bootsteps were drumming down the northeast stairwell; evidently, the army didn't trust elevators. ETA at my door at the current rate of progress: four minutes, sixteen seconds. I boosted my hearing further—yes, elevators were still running.

I did some hurrying of my own, grabbing a utility knife from the kitchen and two microfiber suitcases from a closet, then cutting the back out of each suitcase and poking several tiny holes in the front of the smaller case. Alison watched silently with puzzled eyes. I stripped off all my clothes, stuffing them and the detached microfiber rectangles into one side of the smaller case, making sure not to block the light seeping through the pierced front.

"I'll be going through some . . . changes, Alison. Don't be alarmed." I knew I looked far less human without clothes.

"All right."

My feet are attached to my legs with tricky little camshafts it took me years to perfect. But it only took a moment to revert my feet into wheels. Narrowing my legs into rods was also quick work, but needing some way to hide the extra mass, I held the big suitcase to my lower torso and filled it full of me. The extrusion hid the back and supported the luggage, thus freeing my arms for more important work.

"Brace yourself," I said quietly. "I'm going to try repeating something that happened to me by accident. If, ah, I fail to catch my head, please pick it up and stick it back on my neck."

Without waiting for an answer, I held my arms out and commanded my head to pop off. The room seemed to shoot upwards and I lost touch with my body. But my head came to a soft stop even before Alison gasped. The next part was utterly experimental and if it failed, I'd need a plan B and fast. But I had a hunch. . . .

Maintaining an internal silence—my version of holding my breath—I shoved my head against my upper chest, begging it to attach in this unnatural position. To my great relief and mild surprise, it did. My normal sensations flooded back, although I had to migrate my eyes to get them pointed forward. Evidently my sense of touch reached my head through something other than fixed nerve paths.

It was odd suddenly feeling so much shorter and my balance was off for a few moments, but the weirdest thing was suddenly repossessing a clear mem-

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ory of *arriving* on the Moon, leaving an artifact that was nothing like any human concept of a starship—all diaphanous veils and champagne bubbles. But this was no time to reminisce, so a moment later, I'd stacked the smaller case on the larger and wriggled my head inside the top case far enough to see out through the holes I'd made. Lifting my arms, I thinned them into tubular brackets, using the extra material to expand my neck into a luggage-holding clamp, which covered any suspicious gaps behind the upper suitcase.

"How do I look?" I asked.

She shook her head. "Incredible! Just like an auto-carrier! The kind that follow their owners like obedient dogs."

"That's the idea. Those lumps on my legs are supposed to be motors."

"They look it."

"Listen, Alison. Once we're outside this room, we can't risk anyone hearing me talk. So here's the plan. We'll move into the hall and dash to the elevators to our right. You'll probably need to push the down button. Once the lift arrives and we're inside, press the lobby button and don't say anything; the elevator has a security feed. Any questions so far?"

"I—I guess not."

"Good. The lobby will likely be filled with soldiers and you should follow their instructions. If anyone wants to know about you, try not to reveal your last name, but say you've been apartment-sitting for Sharon Weiss in 26E who's coming home late tonight. Which is close enough to the truth."

"Sharon Weiss. Apartment 26E. Anything else?"

"Yes. If anyone asks, you're on your way to, ah, Penn Station and Long Island. Leave the building if you can. I'll be right behind you and we'll play it by ear. If the authorities won't let you leave, listen for whoever is issuing orders. After about ten minutes, approach that person and tell him or her that you're pregnant and . . . very hungry. If that doesn't work, stand close to me and I'll whisper some new suggestions." Assuming I could think of any. I could envision a thousand contingencies, but we were out of time. "We've got to hurry now."

If my apartment building had slower elevators we wouldn't have made it. As it was, the doors closed behind us and we were headed down when I heard the stairwell door on my floor crash open. Even over the whine of cables on pulleys and assorted hums and rattles, the pounding on my apartment door sounded like an attack.

Leaving the building was no problem; soldiers practically shoved Alison outside and I followed with appropriate programmed loyalty. Then we only had to go five blocks to catch one of the mainline busses, the ones with big ramps for wheelchairs and faithful auto-carriers like me.

Jon Norhaart was just knocking on the Guru's door when Alison and I arrived. If Professor Moshe Besden was surprised to have two members of the Norhaart clan on palpably bad terms suddenly descend on him, or to witness me relinquishing my job as an autonomous luggage-carrier after I'd rolled into the foyer—including repositioning my noggin—it didn't alter his usual benevolent smile. No doubt my mentor had already outlined the situation via telicell. As to Jon himself, his jaw dropped at my latest trick, but then he clamped that jaw tight, perhaps to avoid any comments leaking that might lead to interacting with me.

While I rejoined human civilization somewhat by retrieving my clothes from the larger suitcase and getting dressed, Besden battened the hatches, locking the outer doors and scurrying around closing curtains, humming cheerfully.

But the subsequent scene around the Guru's mahogany lozenge of a dining room table was anything but cheerful.

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After studying her father's face briefly, Alison didn't even try to talk to him and he wouldn't glance at her. And he was unmistakably furious with me for ignoring his wishes and bringing her along. Perhaps this meant I'd achieved that state referred to as "being in the doghouse." If so, it was hard to imagine any canine enjoying the experience.

I sat in an oversized armless chair, stretching my legs out beneath the table to keep my knees low, and reread two hundred memorized psychology books without gleaning the faintest clue about how to get Jon to forgive me so I could talk to him about forgiving Alison.

The Guru attempted to brighten the mood by offering a braided sort of raisin-bread, cheeses, the latest designer apples called "Sweet and Sours," and *hamentoshen*—triangular cookies that he explained were a traditional part of the current Jewish holiday. "I try," Besden said, patting himself on one massive thigh, "to give at least hip service to all the noshing holidays. Purim is no exception."

When his efforts and good humor fell flat, the Guru sat as quietly as the rest of us, contemplatively rubbing his chin with its usual one o'clock version of five o'clock shadow.

A somewhat short man, Besden resembled a gorilla and was nearly as strong and hairy, yet his broad face radiated friendliness and his small dark eyes brimmed with intelligence and warmth. I hadn't yet determined exactly what subtleties of expression and underlying structure produced such pleasant effects, and I'd been working on this mystery for the last two years.

According to *Time Webzine*, Besden was a "towering figure in high-energy physics," and "a person of profound insight into nature, including human nature, who wields administrative skills inspiring fanatical loyalty in those fortunate enough to work for him." Doubtless the description was accurate if adjective-heavy, but it wasn't these qualifications that had earned him his nickname. I understand he'd been dubbed "Guru" due to a temperament so calm, even an animate inanimate such as myself found it soothing to be around the man.

Still, the tension around the table must've tested even his limits, and it didn't ease when the doorbell rang. Besden said he wasn't expecting anyone, but we all know how people do drop in, which was news to me. Then, while I wondered what kind of people dropped in on the Guru, I heard our host thread the maze of his home to his foyer, open the front door, and invite someone inside in a tone pitched to carry into the dining room, and then some. An unfamiliar male voice with a slight southern accent and a nasal twang complained, "You don't need to yell, Moshe, I'm not deaf yet. And why are your curtains closed?" Besden claimed he'd had a migraine earlier and keeping the sun out had helped the pain. The Norhaarts sat tight, so to speak, and I quickly dimmed the dining room chandelier to support the migraine deceit, headed to the nearest bedroom, silently shut the door, boosted my hearing, and worried.

How could I bring Jon and Alison together? Clearly, they were desperately unhappy as things stood. Their misery was making me miserable and Jon's anger toward me was hard to bear. On top of that, I felt frustrated at losing my chance to see one of the Guru's personal friends. I knew almost nothing about the physicist's private life.

Meanwhile, Besden slowly led the newcomer to the dining room where he introduced the man as "Dr. Joshua Hewitt, an old buddy." The old buddy greeted Jon and Alison, then, finding himself virtually snubbed by both Norhaarts, steered a casual conversation with the Guru in a direction that surprised me, concerning God, creation, the Bible, and what the doctor referred to as "the great blindness" of

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modern science. I gathered this was a running argument and Hewitt was something of a self-anointed evangelist. I wondered how the Guru could be friendly with someone so belligerent about converting others to his belief system.

Normally I would've found such a discussion fascinating, but today it seemed annoying and irrelevant. I just wanted Hewitt to leave and perhaps Besden felt similarly because Hewitt sounded taken aback by the Guru's responses.

"You're not proving anything to me," Besden said, "when you use the Bible to support the Bible. And frankly, the way you thump it gives the Good Book a hollow ring."

"You don't accept the authority of God?"

"Josh, I've told you this before: as far as I'm concerned, *human beings* wrote the Bible, even the Old Testament. I like to think God was speaking through those writers, but can't imagine the information coming through . . . unfiltered. Not to mention translation issues and how something as vast as God could express Himself fully through a gateway as narrow as any human language."

A strange thing happened. Suddenly, the argument seemed intensely relevant to me and I strained to absorb every nuance.

"I believe you are more lost than I'd realized, Moshe!"

"And I believe that you, my friend, have been disobeying the second Commandment of the Decalogue."

"What? How so?"

"Haven't you been worshiping the Bible itself, a graven image in its fashion, rather than God?"

"Nonsense! The Bible *is* God's word."

"Perhaps, but if God's word is written anywhere, surely it's written in nature. And if taking the Bible literally, as you've urged me to do for the last decade, means trying to believe the universe is only thousands of years old—"

"It is! Hundreds of good scientists have proved it! If you look at the gaps in the fossil records—"

"And my own observations and those of thousands of scientists working in a dozen different fields indicate the passage of years in the billions when you study the interdisciplinary evidence. So for me, taking the Bible literally would be *denying* God."

A long moment of silence. "You think what God has written in nature isn't filtered by your so-called scientists?"

"I'm sure it is. But they tend to compete to find the truth and the good ones avoid beginning from the standpoint of proving any specific case."

The dispute rattled on for another fifteen minutes and twelve seconds, but Hewitt sounded increasingly distracted and whatever I was listening for so closely never emerged. When the door closed behind the evangelist, not quite slamming, I rejoined the remaining group. Neither Norhaart had said a word for the last twenty-four minutes although the professor's response when religious issues arose had previously always been: "We Unitarians believe in one God. At the most."

Still, for some reason I didn't understand, Hewitt's visit or perhaps his departure had done some good. Jon was sitting less stiffly and would occasionally peek sideways at his daughter as if considering opening a dialog. Alison was pretending not to notice, but traces of color had returned to her face. As to the Guru, an extra hint of smile played with his lips. His eyes were closed, moving beneath their lids. Since it was unlikely he was engaged in REM sleep, I deduced he was probably watching celivision.

"I've been thinking," I said right away. "Won't the authorities find me here before long?"

Besden opened his eyes and his smile widened. "I daresay they'd be here now if they weren't convinced they had you

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trapped somewhere within your apartment building. You were observed and recording entering; I've just seen the feeds. You definitely went in, and as far as the experts are concerned, you couldn't have gotten out."

"I don't follow the reasoning. Surely they would've found me by now if I were still there?"

Jon finally cracked his long silence, beginning with a sigh. "A forty-plus-story building, Dan, offers an abundance of hiding places, particularly for a hider who can move around as quick as you. And they may suspect you have other . . . hidden resources."

"I see." But I wasn't wholly convinced.

A strange late afternoon and evening, even stranger than my usual. Through much trial and error, the Guru found discussion topics that drew out both Jon and Alison. They never addressed each other directly, but used Besden as a conversational reflector, bouncing ideas obliquely back and forth. I was surprised by how I felt about this. A new sentiment had entered my emotional repertoire: hope.

After serving his eating guests a thick lentil stew for supper—Alison had a teaspoon's worth at the most—Besden offered up a dessert that he promised contained enough heavy cream to burst a major artery. Despite this inducement, both Norhaarts insisted on making it an early night and went off to guest bedrooms on opposite sides of the house. The Guru waddled away to fetch sundries such as extra towels, and when he returned we were alone.

He perched himself across the table from me in a heavily cushioned chair while I slanted my legs to give him room. He studied me, subtly beaming as usual, and raised his bushy eyebrows as if offering me the chance to speak first. I took him up on it.

"Overheard your argument with Dr. Hewitt."

"A good day for one of our extended debates this wasn't and I fear I was rude."

"But why argue about religious matters at all?"

He tilted his head slightly. "I'd say we both get something out of it. It strengthens his faith to tussle with me; right now, I'm sure he's at home finding flaws in my latest arguments. And I find it useful to have someone around to remind me that not everyone thinks as I do or believes what I believe."

"What do you believe?"

"Concerning Truth with a capital T? We Jews had a single major insight several millennia back, that there was only one Deity," he chuckled, "something of a Unified God Theory. But since then we've, um, reached no consensus on God's precise nature. Many of us feel human limitations make such questions unanswerable. Tell me, Dan. Do *you* believe in God?"

"Me? Haven't really thought about it. But no, if what you mean by 'God' is some person standing outside or beyond this universe and controlling its . . . its every—"

"Pulling its strings?" he suggested with another chuckle. "Excuse me. A physics joke, to my shame. You don't buy into the white-bearded grandfather hypothesis?"

"The idea seems pitifully anthropomorphic. As does any claim that God created man in His own image."

He leaned forward. "You sound almost angry, my friend."

"That's not—well, I am feeling something strange. But don't forget that beings more advanced than your species definitely created me and they definitely *weren't* human."

His eyes practically glowed with curiosity. "Interesting point! And I find it equally interesting we're having this discussion rather than the one I've been expecting. All day, you haven't asked a single question concerning how we're going to handle your situation!"

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"Oh. Well, I've always trusted Professor Norhaart's guidance. And yours. I'm sure between the two of you, you'll steer me wisely." This explanation for my unconcern sounded feeble even to me, but I still couldn't bring myself to focus on the future. "Maybe it's because I've got something else on my mind."

"*Nu*?"

I hesitated. "It seems . . . disloyal to talk about this, but I need your advice."

He just nodded encouragingly.

"Jon has been my teacher and friend ever since the army released me. I've never doubted his intelligence or wisdom before."

"But now you do?"

Again, I paused. "Do you know why he's so angry with his daughter?"

"I've some idea. The, um, circumstances of his wife's death got enough local publicity. And I know he expected to have a grandchild at one point."

"That's helpful; I wouldn't have felt right revealing Jon's secrets. So he's been badly hurt; that much is clear even to a robot. But why would someone so clever allow the past to ruin the present?"

The Guru's eyes widened a bit. "Such questions you ask! Are you turning into a real boy, Pinocchio?"

I didn't answer. What *was* happening to me?

He flipped one palm upwards. "I will tell you another kind of secret, my friend. In human families, irrespective of race or status or brains, dysfunction is the rule, not the exception."

"Really? Why?"

"I can't flatter myself into certainty, but would you care to hear my theory?"

"Please. Tell me."

"I think perhaps it's because as a species, mine is still very young. And the human mind, like so many immature and growing things, is so, um, reactive." He leaned back, interlacing his hands over his stomach. "The consequences of mistakes our ancestors made remain with us, reverberating through the generations. And who suffers the wake or maybe the bow-wave of our ignorance, Dan? Our children. Who grow up to inflict ignorance on their children."

Something powerful moved inside me. "Do you think the human race will eventually—eventually mature?"

He was silent a moment. "Truly, I do. In fact, seems to me that *Homo sapiens*, all over our world, *already* exists simultaneously at a thousand different steps in evolution. It's as if some of us have been here for a million years, and time has chipped away our sharp corners and softened our brutal bones. While others have just showed up, still greedy, selfish, and violent. How else can you explain how, in any given hour, individuals from a single species can sink to such destructive depths or rise to such heights of compassion and self-sacrifice?"

"I don't know. But getting specific, what about Jon? Do you think he's too immature to forgive Alison?"

The Guru smiled at me and stood up. "Faith I also have in Jon. And I think the circumstances of his life are conspiring to force him to, let's say, evolve quickly. Enough. On a practical note, Dan, tomorrow morning we're going to smuggle you up to a friend of mine in Connecticut. So I must bid you a fond good night. Unlike a certain wonderful machine with a golden heart, aging physicists need their beauty sleep."

I didn't feel like sitting in the dining room alone, so I emigrated to the living room and lowered myself slowly onto a large leather couch, listening for warning creaks. The couch was as sturdy as the Guru himself and it accepted my full weight without complaints.

But I had complaints. Suddenly, the idea of doing something so human and ordinary as nursing a cup of hot coffee or cocoa was powerfully appealing, but I lacked any sense of taste and had nowhere internal to store beverages.

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Dan the Can was a perpetual outsider staring in through the windows where humanity lived, longing for a touch of that coziness. On the bright side, apparently I'd finally become human enough to feel sorry for myself.

I didn't question Besden's assessment that people occupy differing stages of ethical development, but unlike me, humans were so *connected*. . . .

"What do you mean," asked a voice at my side, "by 'connected'?"

Startled, I turned and saw a duplicate me sitting next to me; this sort of thing is how I dream, but being twinned was a new twist.

"People," I explained as if there was a point in telling myself anything, "have so many similar experiences. And they're also connected by the way they constantly watch and learn from each other. Among humans, ideas spread faster than—"

"What sort of ideas?" Dan Two interrupted.

"What is this? A fresh way to think out loud?"

"Trust yourself. What sort of ideas?"

I wondered if warping my mouth into a frown would be the height of absurdity or merely near the summit. "All sorts. Do we really need an example?"

"Can you offer one?"

Was that an edge of contempt in my voice? I was beginning to dislike my attitude. "Fine. Two months ago, a celebrity chef named Brian Bain opened *Focus*, a novel form of restaurant featuring long griddles on which various soups or gravies are reduced to thick pastes, spread on various breads, and served. Bain called his concept a '*fond* bar.' Since then, fourteen such restaurants have sprung up in Manhattan. In two months!" I watched myself for a moment. "But we both know all that. So where is this leading?"

"What made you choose that particular example?"

"I don't know. Why should—"

My other self was gone. Well. The question remained behind. Something in the example *had* struck me as personally relevant, aside from the point I'd been supporting. Surely it couldn't have anything to do with concentrating flavors by condensing goop? Or could it?

Come to think of it, almost everything I'd experienced recently had carried a private impact: Alison's situation, Jon's reluctance to shed a past that weighed him down so, the jammed-up trucks, the Bible argument. . . .

Today, significance seemed to be raining on me everywhere I turned. Was it all some incredible chain of coincidences? I didn't believe it. But it sure had been one hell of a day, beginning with a literal sort of bang.

I replayed the morning events at Lincoln Center with unpleasantly perfect fidelity, including my thoughts at the time, and stopped on a specific thought: *Perhaps Professor Norbaart is right about me having a subconscious because the exact telemetric etiquette was already waiting for me as I reached for it.*

Of course I had a subconscious! Hadn't I been talking with the damn thing a few seconds ago? And it sure seemed to be pushing me towards . . . something. Why? What did it know that I didn't? Was it possible this usually buried part of my mind had jumped to some new conclusions and would've jammed significance into *any* experience that might've come my way?

I let the day's events roll by at high speed, then put the brakes on the final scene in my apartment and some important information I hadn't had the leisure to fully absorb. I'd found I could still function with my head—or would sensorium be a better term?—attached to a part of my body aside from the neck. And when it had been stuck to my chest, a lost memory had returned.

This could be the key! Right now, with my head on properly, I could recall *remembering* first rolling on to the lunar surface, but could no longer ac-

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cess the memory directly. So I had to ask two questions: could my cranium attach anywhere on my body? And would different locations retrieve different memories?

This morning, had my subconscious knocked my block off, so to speak, as a hint? If so, it seemed my intuition was capable of starting the ball rolling, again so to speak, but needed my conscious cooperation to achieve its aims. And it wasn't hard to guess those aims involved retrieving lost memories. So where, exactly, did the inner Dan want my head attached? I didn't expect an answer to that question, but I got one.

Without my permission, the arms I keep clamped at my side held themselves out, the end-grips unfurling into humanoid hands, their palms turning upwards. I knew they were waiting to catch my head and I felt something else I'd never felt before: terror. Of the unknown.

Even before the first shreds of dawn had outlined the living room curtains, I heard rumbling coming up the street outside. My guiding professors had underestimated the military, but it no longer mattered. I put myself back together and invaded Jon's bedroom-in-exile.

Initially, my mentor acted groggy and disoriented, but one minute and four seconds of me expounding seemed to cure him of all sleepiness, although his skin became paler the more I talked. At his insistence, we roused Besden, whose most noticeable response to my little speech was to stop smiling. While I spilled the beans to the Guru, Jon stood shivering although the room was, if anything, a trifle warm for human comfort.

Then Besden tilted his head and cupped one ear. "Dan, am I hearing voices outside?"

"That's possible, although you could also be hearing the sound of fifteen different large engines idling and troops hurrying to set up heavy equipment in the alley behind us. The sonic landscape is rich this morning."

"For *God's sake*!" Jon groaned. "Are you telling us the army's already *here*?"

"Some of it, at any rate. I imagine the scene outside the front door would appear somewhat intimidating."

He stared at me for a moment. "In the light of what you've . . . revealed, wouldn't you say we're pretty well—"

"Screwed," Besden finished. "Unless we can get the brass to understand the danger before it's too late. Or is it *already* too late, Dan?"

"Don't know, but wouldn't it be most practical to assume we still have enough time to fix this?"

"I'll go out there and talk to them," Jon offered. "Somehow, I'll *make* them believe—"

"Not you, bubeleh," Besden said firmly, launching out of bed and into a terrycloth bathrobe describable as "ratty" if the describer had no respect for the grooming ability of rats. "And not our friend here either. *You* couldn't sell cream cheese at a bagels-and-lox convention, and Dan they might attack. We know I'm good with people because *Time* said so."

While Besden headed out his front door, Jon and I occupied the living room. I cracked the curtains open a few inches and cranked up my hearing. Alison, wearing rumpled clothes from yesterday, joined us with frightened eyes but no immediate questions. As we all stared outside, the Norhaarts drifted closer as if drawn by gravity and I wondered if Jon was even aware of pulling his arm protectively around his daughter. His action, conscious or not, warmed me.

And the Guru impressed me. There was a nobility in the way he faced the wide arc of soldiers, heavy weapons, and armored vehicles, only enhanced by his tatty robe and bare, hairy calves. A true act of courage—but then, and I suppose this is often the case, the alter-

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native seemed worse. He held his arms high and spoke slowly, clearly, and without quite shouting.

"Can you hear him, Dan?" Jon murmured, leaning away from me as far as he could without losing his view. "What's he saying?"

I was saddened that Jon had come to fear me. "My name," I said in the Guru's voice, "is Professor Moshe Besden and I have vital information for whoever is in charge. Believe me, this information you need to hear."

While soldiers kept weapons trained on Besden, and other soldiers kept weapons aimed at the house, a large man bearing a silver eagle on one collar emerged through the ranks and stood facing the Guru, towering over him.

"Colonel Ayers here," I repeated, switching to Ayers's vocal attributes. "You can lower your arms. What's this information?"

"Colonel, please listen carefully! We've just now learned the so-called Moon Robot is no mechanical servant. It's closer to being—well, Dan used the term 'remote initiation system.' "

Ayers glanced toward the house before responding in a hoarse voice that was harder to duplicate. "You're claiming the robot is some kind of *detonator*?"

"I'm afraid so."

"For *what*?"

"The extraterrestrials who built him buried a terrible weapon somewhere on Earth. A biological bomb. Through the robot, the device has been programming itself to specifically target human DNA—don't ask me to explain how it works. But there's apparently no way we can disarm such an advanced weapon, even if we could find it. I understand the robot is the aliens' way to test how civilized our species is. Should Dan be destroyed or even moved too far from the bomb—past the Moon's orbit, he thinks—the bomb will explode or ignite and we'll all be massacred."

"*Christ*! How the hell did you learn all this?"

"Dan told us. He's just regained some early memories. Somehow his builders guessed intelligent life would appear on Earth and they installed their robot on the Moon to insure we'd have developed spaceflight before our treatment of Dan would determine our fate."

"Why should we believe—"

"Colonel, can we afford to *disbelieve*? And I haven't told you the worst. Dan has grown . . . fond of us and fears your threatening actions have already triggered a sort of countdown timer on the bomb."

Ayers, his long face now stiff and waxen, stared at the Guru for a long moment. "If so," he croaked, "what can we do? If we can't attack the robot or put it on a spaceship to nowhere—"

Besden held up a hand and a hundred rifles that had been lowered a trifle suddenly snapped back into place. The Guru ignored this. "Dan says there's one place that will automatically deactivate him and stop any countdown. But we've *got* to get him there right away. And even Dan doesn't know how long we have."

I'm sitting on a rock, chuckling, and it doesn't matter that this cave lacks air to carry sound, because no one else is with me. In fact, the nearest humans are two hundred twelve kilometers away at Moonbase Two.

Lying hadn't proved difficult after all. My first attempt had been a total success.

And I won't be alone for long. I've activated the retrieve signal and my handlers should be along within a month to ferry me to my next assignment.

Of course, the bomb was utter fiction. Those gentle beings who created me would regard such a concept with horror. My builders view themselves as gardeners whose gardens are entire galaxies while the developing plants under their care are intelligent species. A spot of watering here, a bit of fertilizing

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there, and never, save in one terrible case, any pruning. They'd been at this for a million years and counting.

But when you tend *alien* gardens, you'd best understand the flowers and soil. That's where I come in and those like me. We're not robots so much as empathy machines. Even still, it is a slow and cautious process coming to understand each new species, with inevitable missteps along the way. My work is never complete until I feel myself to be nearly one of those I study, close enough to speak on their behalf. On this assignment, it has taken me nearly thirty Earth years to reach this level.

Then, comprehending humans at last, it was almost too easy to trick them into returning me here.

But in matters of deceit, the gardeners put me to shame. Thirty years ago, I'd been on the Moon a mere two weeks before humans noticed my radio beacon and found me. The physical evidence of my eons-long residence in this cave had been wonderfully faked. The subjects of my investigation would've been far more suspicious if they'd known how recently I'd arrived.

And now, for the first time in decades, I truly have a little time to myself, a little non-breathing space. While waiting to be retrieved, I'll decide exactly what to tell my builders and savor my memories of Earth and the people I'd known. I have much to savor. My lie had leaked, which I should've expected and didn't, but the fear it engendered not only brought the Norhaarts together, or at least gotten the process well underway, but it had done a world of good. A threat of extinction makes a marvelous wake-up call, pushing aside a broad spectrum of animosities from the individual to the national, and the authorities had whisked me here before true panic could set in.

Yes, my experiences on Earth have been rich and varied, but not all have been pleasant. . . .

The gardeners had given me a head start, so to speak, by reconfiguring me into a humanoid shape, although they apparently couldn't accept the necessity for only two arms. But then, actually being among humans and trying to humanize myself had proved hideously confusing at first and involved much unlearning and many errors. The process was traumatic even for a self-educating machine. No wonder I'd resonated so strongly of late to anything involving abandonment, mistakes with long-term consequences, gridlock, or loneliness.

No mystery at all, having so many recent and disparate experiences carrying the weight of personal relevance! The stuck trucks had gotten under my metallic skin because they'd reminded me of my work, where understanding one alien concept is often blocked until a second concept is absorbed, which in turn requires understanding the prior concept. And naturally, the Guru's comment about God being unable to express the truth fully through human languages had struck my equivalent to a nerve; the issue for me hadn't been theological but a question I felt instinctively but couldn't have formulated at the time: how can something more than human communicate through narrow human channels?

Even using a *fond* bar as an example in arguing with my dream self had its logic. What had I been doing all along but condensing the gravy of experience into the paste of understanding?

This metaphor is so absurd it makes me laugh, which doesn't touch the silence around me. How I appreciate this human humor so recently learned and laboriously earned, and I'm sad to think of never seeing Jon, Alison, the Guru, or any of my human friends again. But I'll get over it. Soon, I'll be forgetting them all and the learning will begin anew. And this is good.

I'd been made for this. ■

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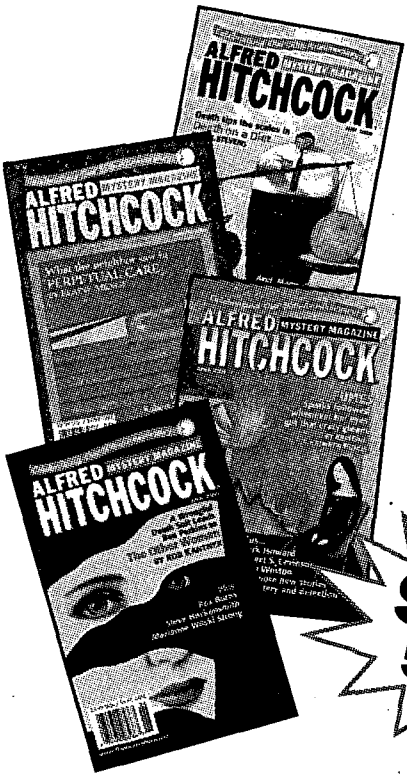

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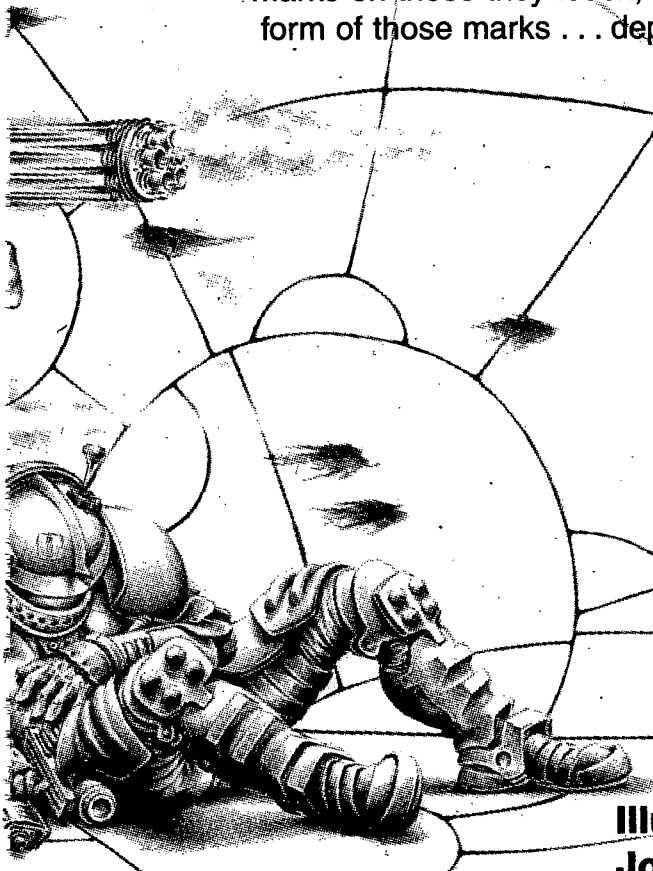
Conclusion

A NEW ORDER OF THINGS

Edward M. Lerner

Major catastrophes leave indelible marks on those they touch, but the form of those marks . . . depends.



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Synopsis

For a century and a half, a growing interstellar community has maintained radio contact. A vigorous commerce in intellectual property has accelerated the technical progress of all its members. Travel between the stars seems impossible, but InterstellarNet thrives using an elegant alternative: artificially intelligent surrogates who act as local representatives for distant societies. Quarantine procedures strictly govern the delivery and operational environment of each alien agent, protecting agents and their host networks from subversion by the other.

A radio message shatters this comfortable status quo. The signal comes from a habitat-sized decelerating interstellar vessel, its unannounced trip from Barnard's Star now ninety-nine percent complete. Citing damage en route and low supplies, the starship Victorious *goes to Jupiter rather than Earth. The starship's crew are whippet-thin, iridescent-scaled, bipedal carnivores who call themselves Hunters. Humans refer to them as K'vithians, after their home world of K'vith, or, informally, as Snakes (because Barnard's Star lies in the constellation Ophiuchus, the Serpent Holder).*

Not only humans are surprised by Victorious' *short-notice arrival.* ***Pashwab****, the AI trade agent on Earth for the Hunters, is also taken unawares. So are her internal sub-agents, the representatives of the Great Clans. Pashwab rejects unauthenticated demands from the starship for Great Clan InterstellarNet credits with which to buy supplies, but does transmit to* Victorious *a translator and human-affairs advisor: a partial copy of herself named* ***Pashwab-qith****.*

Ambassador ***Hong-yee Chung*** *heads the United Planets response team, assembled on Callisto. His technical support team includes theoretical physicist* ***Eva Gutierrez****, xeno-sociologist* ***Keizo Matsunaga****, and Interstellar Commerce Union executive and systems engineer (and long-time claustrophobe)* ***Arthur Walsh****.*

Most humans have forgotten, or at least forgiven, a half-century-earlier inter-species crisis. Art is not among them. The "Snake Subterfuge" involved a trapdoor hidden in licensed Snake biocomputer technology, potentially compromising most human infrastructure. That crisis ended when Pashwab was convinced that one corporation's extortion plans must not destroy overall inter-species relations. The biocomputer vulnerability has long been removed.

Antimatter is extremely *dangerous stuff. The United Planets antimatter production facility—built to stockpile fuel for a nascent interstellar-drive research project—remains top secret, undisclosed, and hidden on Jupiter's distant moon Himalia. Unbeknownst to the UP, patient data mining over decades has revealed Himalia base's secret to both Pashwab and* ***T'bck Fwa****, the AI trade agent on Earth for the intelligent species native to Alpha Centauri A.*

There is a conspiracy at hand, and it involves T'bck Fwa's patrons: the Unity. Twenty years earlier, the Unity's prototype starship, then named Harmony, *was boarded and captured on its final approach to Barnard's Star.* Harmony's *rightful crew awoke from suspended animation into K'vithian captivity. Members of the Unity, whom humans call the Centaurs, are herbivorous, green-furred, land octopi.*

K'choi Gwu*,* Harmony's *ka, or leader by consensus, surreptitiously sabotages the shipboard environmental systems. She knows that only a fresh supply of home-world biochemicals can avert eco-collapse. Reconfiguration of human chemical plants to*

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mass-synthesize the exotic materials will surely be expensive. It's a ruse to justify her feigned reluctant disclosure of a fortune in InterstellarNet credits hidden deep within the suppressed shipboard AI. Gwu's captors believe they reactivated the lobotomized AI just long enough to retrieve the hidden financial codes, but ***T'bck Ra*** *successfully hides himself in computers distributed across the starship. An attempted SOS transmission to T'bck Fwa on Earth is interrupted before it is completed.*

T'bck Fwa already suspects a human/K'vithian conspiracy. His suspicions grow when he finds biochemicals appropriate for the biosphere of a Unity habitat being delivered to the Jupiter system. The SOS message fragment from the starship seems to confirm all his suspicions.

Firb Mashkith*, Foremost of clan Arblen Ems and the starship he has renamed* Victorious*, has more pressing matters on his mind than a declining ecosystem. Arblen Ems, once a Great Clan, and hence privy to Pashwah's long-ago discovery of the antimatter program at Himalia, had overreached politically. All other clans had united against them. His people were driven to the fringes of their solar system and hunted to the brink of extinction. Then, twenty years ago, a starship had emerged from the outer darkness. It embodied technology—antimatter and interstellar drive—far beyond the capabilities of* any *clan. But Arblen Ems had become too weak to protect its prize. . . .*

Mashkith's boldness has changed all that. The interstellar drive, however esoteric in theory, is easy to reproduce. His problem was and remains fuel. The captured starship carried antimatter for a round trip; the antimatter intended for the return flight has instead been used to reach human space. He has already sent a rigged lifeboat back toward Alpha Centauri. The lifeboat radioed a contrived distress call and then self-destructed, to disguise the piracy and make the Unity distrust their own technology. If he can now trick the humans into disclosing how they handle antimatter on very large scales, Arblen Ems alone will have access to the stars.

Art and Eva have both worked in the secret labs on Himalia, so the K'vithian rationale for picking Jupiter as their destination rings false. Still, a demo using a sample of antimatter from the starship's reserves convinces them that K'vith must already have antimatter technology. The demo, like the large patch on the ship's side, supports Mashkith's assertion of an en route accident that destroyed his antimatter-production equipment. Without human-supplied antimatter, Mashkith tells the UP, Victorious *is stranded.*

Mashkith's senior officers, ***Rashk Keffab*** *and* ***Rashk Lotbwer****, disparage human antimatter technology. After detailed interviewing of UP experts, the K'vithian engineers declare themselves reluctantly convinced: "Primitive" human techniques can safely transfer to* Victorious *large amounts of antimatter. In practice, they have tricked the UP into disclosing all the clan needs to know to produce and manipulate antimatter on a grand scale.*

After a second contrived demo, this time of a lifeboat left pre-positioned in the Kuiper Belt, the UP agrees to swap a load of antimatter for the lifeboat and its interstellar drive. Victorious *is refueled from the UP stockpile on Himalia. Chung, Eva, and media star* ***Corinne Elman*** *are among the humans then given a ceremonial orientation cruise when the bartered lifeboat is transferred.*

The UP antimatter facility explodes catastrophically, killing thousands,

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much as Snake engineers had warned. The blast shatters Himalia, cripples the naval fleet guarding the no-longer-secret facility—and destroys the returning lifeboat filled with human scientists and dignitaries.

Art's friend ***Helmut Schiller*** *has a shadowed past: As* ***Willem Vanderkellen****, he made a major mineral find in the Belt, only to fall afoul of a claim-jumping criminal syndicate. Under his assumed name, Helmut works as a pilot for Corinne. Long years hiding from the mob has honed skills in sensing danger and deceit. He and Art work out how a Snake lifeboat* caused *the Himalia disaster—and that it was not the lifeboat that their friends boarded. That ship, with Himalia's top scientists presumably held prisoner, is seen creeping away, far above the ecliptic.*

Pashwah-qith has flooded the black market with Centaur credits, using the proceeds to re-supply Victorious. *The unexpected surge in Centaur credits flowing into the banking system provides a critical clue how to reconsider past anomalies. Art deduces* Victorious *must be a hijacked* Centaur *starship—*

But what can the UP do about any of this? The Himalia disaster has destroyed or disabled most human naval resources in the Jovian system. Arblen Ems warships that sortie from Victorious *rout the few remaining UP forces. The starship recovers its escaped lifeboat, now free from human pursuit, and rigs for another interstellar voyage. Mashkith is exultant. He now controls the secrets of the starship drive* and *antimatter production, and prisoners who are expert in both.*

Mashkith locks his human captives into the agriculture sector of the starship with the Centaur crew. Corinne and Eva immediately begin conspiring to steal and escape aboard a lifeboat.

As Victorious *recedes into the interstellar darkness, Art, Helmut, and UP intelligence agent* ***Carlos Montoya*** *approach the UP Navy with a desperate plan. . . .*

CHAPTER 36

Two gees got old quickly, even two scant K'vithian gees. Helmut's "co-pilot" squirmed in his acceleration couch, tugging a wrinkle out of his shirt even as, sure as cosmic rays and taxes, some new crease formed to press against his sore back. "Are we there yet?"

Helmut tweaked his sensors before answering. "Art, that's gotten about as old as, 'You're sure this is going to work?' The answer is also the same. No. Ask again, and you can ride in back."

The display imaging their hastily retrofitted payload bay showed Carlos' UPIA special-ops team hard at work despite the ship's acceleration: stripping and reassembling weapons, checking out comm gear, packing ammo, while their officers studied and mapped every surmise and scrap of data ever collected about *Victorious*. They had launched with little notice from Callisto to fly the suicide mission he and Art had pitched. Anyone who considered two gees troublesome kept that frailty to himself. Helmut guessed his passengers would be far less tolerant of Art's nervous kvetching than he.

Fifteen minutes passed before Helmut broke the silence. "We're well past halfway there, if that helps." Another stretch of quiet. "Okay, I admit it. My nerves are pretty well shot, too. This is far too long to spend feeling like we're wearing a bull's-eye."

Within the main holo into which Art obsessively stared, *Victorious* was a hot fusion flame amid a vastness of nothing. The last Snake support ships had all easily overtaken the starship and docked days ago. "What are they thinking?"

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"They're delighted to see us. We're comrades in arms, returned against all odds after a near-death experience at the hands of the evil but inept humans."

The trick was in sustaining that false belief.

Both Snake losses in the recent combat were self-refueling: scoopers. Skimming a gas giant for fuel was pretty simple in concept; the physics of streamlining meant all scoopships looked much alike. *This* scoopship had had its fusion reactor detuned, so that it ran at the cooler-than-human-norm Snake level. Cosmetic scorch marks discolored their hull, with intent to simulate battle damage. That assumed they got near enough for a close inspection.

The special magic—and the rescue mission's only hope—lay in the nuller, by comparison with which Helmut's long-ago black-market model was so much regolith and duct tape. The UPIA version was customizable; more than merely canceling the ship's true lidar and radar echoes, it emitted false echoes to mimic another ship. The navy had had plenty of radar images of unstealthed Snake ships to work from, data captured in the epoch before Himalia.

The periodic hails from *Victorious* continued, and Helmut continued to ignore them. Mashkith was obviously convinced *Deep Throat* was a Snake ship whose comm capability had been knocked out. Obviously—because no squadron had been launched to take them out. The Snake warships did three gees without difficulty, even though the starship evidently couldn't.

Helmut ground his teeth all the way to the flip-over point. Now, until they doused their fusion drive on final approach, *Victorious* could see little but their hot, but not too hot, exhaust.

And if he could get them just a *bit* closer than that, the special-ops folks in the back would get their opportunity.

* * *

Steal a lifeboat. It was a great concept, Eva thought, but somewhat sketchy on details to constitute a plan. Not that she had anything better to offer. . . .

The starship's acceleration was oppressive, far higher than the Callistan gravity to which she had become accustomed, but at the same time familiarly almost Earthly. A field, or orchard, or vineyard spread all around her, worked by dozens of Centaurs. They might have been unobtrusively observing her, or doing necessary agricultural maintenance, or following some gardening muse. Perhaps they did all three?

None of this is getting me any smarter about Centaur lifeboats.

The only discernable differences between Centaurs were in height and subtle green-on-green fur patterns. She distrusted her ability to tell them apart. "Joe," she queried. "Which one is their leader?" A bright translucent disk flashed in her mind's eye, superimposed over one of the toilers in the field, with a pop-up label that read: K'choi Gwu ka. Evidently Centaurs were not very status-conscious. Art would know. Would she ever see him again? The emotion roiling beneath that question threatened to paralyze her, and Eva tamped it down. "Thanks."

The ground was sodden. Her shoes squelched as she meandered to the Centaur leader. "I appreciate your hospitality, K'Choi Gwu ka."

" 'Gwu' is sufficient." The Centaur straightened from her task, patching the eroded bank of a stream or irrigation channel. "We have little with which to be hospitable."

"All the more reason to appreciate your generosity." Could I sound any more stilted? Maybe it didn't matter, given two translations before Gwu had a chance to assess her words. "Perhaps in time we humans can help."

"Perhaps."

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Steal a lifeboat. If it could be done, why had the Centaurs not done it? "All these years, you've been prisoners aboard your own ship. It must have been terrible."

A weird wave traveled from the tips of Gwu's tentacles to her torso, and reflected. "I do not recommend the experience."

Eva prodded the moist soil with the tip of one muddy shoe. "How did you deal with it?"

"Long ago, I studied humans. Do you know Nietzsche? 'That which does not kill us makes us stronger.' A horrible concept with an element of truth." Her tentacles repeated that strange back-and-forth ripple. "I despair at how strong the crew-kindred has become." And she shared a little of that experience. . . .

The enormity of the Centaurs' suffering overcame Eva. Her selfish prying dissolved into sympathy, her sympathy into empathetic horror.

Reliving the past was far harder on Gwu. Abuse and privation were mere hardships to be endured. Worse was the remorse that gnawed at her: for the lives lost in futile resistance, the dreams unfulfilled, the children foregone, and the lost opportunity to make a difference.

Eva found herself enfolded in Gwu's arms—tentacles had become too impersonal a term—and Gwu in hers. Both were shaking. Captivity, misery, and futility stretched before them all.

It struck Eva she had, in fact, discovered something of vital importance: her resolve. No matter the cost, they—humans and Centaurs alike—*must* escape while human space remained within their reach.

The bridge of *Victorious* had returned to normal, a place of confidence and purpose. The feeling was palpable. Mashkith was almost relaxed, for the first time in years. He would completely relax when the straggler caught up to them.

"Recommendation, Foremost. Sortie of inspection." Lothwer had performed superbly on his recent mission—and he knew it. His suggestions, while polite, had become noticeably more assertive. More . . . challenging?

"Review of available data," Mashkith said.

"Respectfully, Foremost, data inconclusive. Opportunity for expanded knowledge."

"Review of available data." Mashkith put a trace of growl into the repeated order.

Lothwer took notice and summarized. The lone ship struggling to overtake them, to the extent it could be sensed, looked visually and on lidar like *Audacity*. The time and place of its emergence from behind Jupiter was consistent with a strategy of playing dead until it had drifted far from the human fleet. Its exhaust temperature was appropriate for a Hunter vessel. Its engine stuttered and surged, well below its rated capacity. It did not reply to hails.

It was on that last point Lothwer had fixated. "Identification a requirement of doctrine."

Lecturing him on his own bridge about doctrine? One success does not make a Foremost. His aide needed a reminder of roles; perhaps some among the crew needed a reminder who protected them all. "Loss of *Courageous* in rescue of your mission," Mashkith snapped. "Unknown but extensive damage and casualties on *Audacity* for the same purpose." Your success was not without a high cost. "Maybe survivors unconscious, with ship on autopilot. Maybe damage to radio gear, as to engines. Your suspicions unwarranted. Existence of small risk at rendezvous at these speeds. My decision: unjustified risk to crew on return from unnecessary sortie. Denial of your recommendation." He twisted the knife a little. "By doctrine."

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Lothwer had the good sense not to argue further.

As the watch grew long, *Audacity* drew closer and closer. It was almost upon them, engine stuttering on its final approach, when a painful memory asserted itself: another failing vessel, a crash, a gaping hole in their hull.

His family gone.

Mashkith had just netted out a precautionary collision alarm when the ship shuddered.

The precision missile attack pulverized the metal patch in *Victorious*' hull. *Deep Throat*'s close-in laser defenses were briefly busy zapping wayward shrapnel, and then a round of slow-speed, armor-piercing rockets trailing guide wires disappeared into the breach. In an instant, combat-armored marines were jetting along the cables into the rift. Debris blew past the warriors into space.

More missiles fanned out across the target. One salvo attacked every large—interstellar-capable—antenna ever observed on *Victorious*. A follow-up barrage targeted most remaining antennae. A few small dishes were left unmolested. They were too close together to jury-rig into a larger antenna. Retracted antennae were no safer than those deployed in plain sight, the patched area struck by the first salvo having provided an unmistakable point of reference.

And, while the Snakes were presumably maximally distracted, *Deep Throat* disgorged a stealthed vessel from its lifeboat bay.

A sprinkling of far-red alarms shimmered in a mostly orange status display. The herd had designed well; autosealing hatches and self-inflating emergency bulkheads now sealed the area near the break-in. Loss of pressure had been contained, thank the Clan, without affecting the nurseries, hospital, and family dormitories. Attitude jets were already damping the wobble from the explosions. *Victorious* would survive—barring more damage.

"Status," Mashkith snapped.

"Attack vessel on station outside the breach. Armed human intruders in evidence on nearby corridor sensors. Military police in initial response." Lothwer displayed a corridor scene, in which heavily outgunned Hunters were falling back—or just falling. "Distribution of heavy arms and combat armor in process."

"Objective of attackers?" Did he dare to suppress the real-time display of the corridor slaughter? Did it convey critical status, or Lothwer's not-so-veiled rebuke to his recent decision?

"Toward central core. Objective thereafter indeterminate." Lothwer began netting tactical guidance to the assembling forces.

Where might the enemy be headed? Nothing crucial was on the deck they had penetrated. Mashkith assumed the patch had been chosen as a known weak spot. The raiders could go anywhere from the central core, which was why no humans until the recent Himalia refugees/prisoners had been allowed to see it.

Humans had probed *Victorious* early on with deep-penetrating radar, using too many ships at once to be misled by electronic trickery. He had to assume the invaders knew the ship's higher-level structure. "Elevators to disabled state. Inter-deck hatches to latched state." That would slow them down, however briefly. With luck their obsolete maps would confuse them—reconfiguration from spin state had significantly altered the interior layout.

He had taken over this starship with but one ship's crew, but there had been no opposition. The herd had been in suspended animation. Did the humans think a single ship of their warriors could defeat his whole clan? Inconceivable.

Whatever their plan, he would foil

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it. As a first step, "Keffah. Six warships to battle stations. Immediate destruction of human vessel."

Let the intruders, like Arblen Ems, fight with no means of retreat.

The window of opportunity was at most a matter of minutes.

Snake warships would surely be dispatched to destroy *Deep Throat*. Logically, they would be launched from the far side of the starship, rather than make obvious targets of themselves as they emerged from the landing bay. Helmut dove the lifeboat into the landing bay near to *Deep Throat*.

The airlock controls were unfamiliar in labeling but obvious in function. With a squad of special forces in the lead, Helmut, Art, and Carlos slipped into *Victorious*.

Moments later, the network link with *Deep Throat* dissolved into static.

CHAPTER 37

A few pulses of ultra-wideband, wall-penetrating radar would have revealed any opposition forces on nearby decks. Those same pulses might also have disclosed the second raiding party's presence, defeating the purpose of their stealthy entry. The special-ops team relied instead on speed and trained reflexes, advancing quickly into the depths of *Victorious*. Any obviously unarmed Snakes they encountered were disabled with Tasers; anyone else met a few silenced, large-caliber rounds.

There was a large betting pool on how many decks aft they could sneak before someone put out the alarm. Art's money was on two; he was happy for once to have been proven pessimistic.

A massive firefight raged a few decks forward, announced in distant explosions and, on helmet radios, the calm, clipped professional voices of the marines. Capture of the bridge was unlikely, but the high visibility assault in that direction had already accomplished its primary goal: diverting attention from the special-ops penetration. Carlos' smaller team headed the opposite way, to the engine room.

Victorious had elevators, which were likely to be ferrying Mashkith's troops to the battle. The raiders stuck to the stairs, Art huffing from the unaccustomed weight of combat armor. The peripheral stairways typically descended for only a few flights, after which they would burst from a stairwell to hunt for a path further downward. His at-a-gallop guess was that the treads and risers each measured a good thirty centimeters. A peek into a stairwell a few months earlier would have made plain this could not possibly be a Snake ship. Art fell a bit behind, only to bump into Carlos, who was swearing quietly to himself, looking around for the next stairwell. Helmut and the special-ops team had already run far ahead. "What is it?" Art asked.

"The layout is nothing like our maps. How can that be?"

How the hell should he know? Who had ever been allowed into this part of the ship? "It doesn't agree with the navy's ground-penetrating radar scans?"

"Not even close." Carlos paused as a huge explosion from forward shook the ship. "Are we even going in the right direction?"

"No question. We saw the fusion drive running on approach. It was on the ass-end of the ship, like you'd expect. There must be some kind of engine room aft, and ship's acceleration makes clear where aft is. We'll find our way."

There was a burst of gunfire from down the next stairwell, and a brief maniacal cackle from the guy who had won the pool. "Crap. Vacation is over," Carlos yelled, running toward the firefight. "Take over the mapping."

Art shouted at the receding back, "What do you mean?"

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A translucent 3-D corridor map popped into Art's head, sprinkled with red dots. A net address labeled each dot. "Piece of cake. Remember the micro-planes you bought your son and yourself? Think smaller."

Jogging after, Art netted to one of the dots. The POV had a fisheye lens and multi-spectral sensing. From the way the 'bot's course only approximated his directions, it must be gnat-sized and battered by air currents. And—

With a guilty whoop, he began trying out features totally beyond his recently purchased toy. This 'bot did double duty as a wireless router, and it carried for dispersal a cargo of even smaller, non-mobile sensor/router devices. Carlos had been spreading a robust, low-powered comm network throughout the decks and corridors.

Art was imagining new uses for the 'bots when the lights went out.

The incursion was efficient and professional, Mashkith admitted to himself: deadly professional. The attack had almost immediately taken the lives of nine Hunters, with many more wounded. He would be furious with himself when he could spare the time—not that an inspection sortie would necessarily have revealed the deception. Scoopships all looked alike.

The human raiders steadily fought toward the former location of the bridge, their route to that apparent destination circuitous and inefficient. He licked his lips in satisfaction. *Victorious* had been massively reconfigured for acceleration mode. Any interior maps the humans had used to plan their assault were now far removed from reality. In case the humans discovered their error, a squad of the clan's finest troops were posted here on the bridge. Two more squads held a defensive perimeter that included the adjoining rooms and corridors and the deck beneath.

Mashkith thoughtfully interlaced his hand talons. Lothwer had the situation well in hand. The humans fought well, supported one another effectively, and had minimized their own casualties. It was an adequate strategy for defense, but too conservative for their purpose. Bereft of the element of surprise, they were too few in number to prevail.

Talons clicked softly against each other. Something about the situation seemed off. What? The humans were surrounded. In their ignorance, they were moving away from, not toward, the bridge. Their numbers and ammunition were dwindling. The breach had been sealed, and their ship destroyed. Heavily armed Hunter reinforcements were on their way to the battle. The humans' caution was only postponing the inevitable.

Their caution—that was what bothered him. The disguised, all-the-time vulnerable pursuit of *Victorious* had demonstrated great daring. He could not reconcile the two—unless the cautious invaders were a diversion. They were moving forward, drawing his best troops forward. "Lothwer. Your status?"

"Excellent, Foremost. Complete containment of the enemy. Mobilization of our forces. Our counterattack imminent with overwhelming superiority."

The tactical map presented only the front fourth of *Victorious*. Its center was the firefight which Lothwer was directing. That narrow mindset reinforced Mashkith's concern. "What of the remainder of the ship?"

"All quiet. Essential personnel on-post, noncombatants in their dormitories, others on their way to the battle. Lockdown of prisoners complete. Prison access codes reset. Prisoner surveillance ongoing by AI resources." Perhaps recalling a long-ago rebuke, Lothwer licked his lips in amusement. "Risk managed."

How would anyone know if another group of human troops were aboard? Lothwer had concentrated his troops and sequestered the rest of the clan;

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few were in the halls to spot more intruders. Only major corridors had crowd-control cameras. If other invaders avoided those main halls, Mashkith had no hope of detecting them from the bridge.

Proof would come when troops were diverted to look for it. For now it was enough to put himself into the head of the enemy commander. More humans *were* onboard. They would move quickly aft, away from the diversion. The most valuable objective in that direction was the engine room.

"Firh Glithwah," Mashkith called to the squad commander securing the bridge. His niece.

"Yes, sir." She had been but a cub when the voyage began. Now she was taller than he.

"Half your squad on urgent sweep aft. Immediate report of any findings. New defensive position: engine room."

"Sir!" In a flurry of crisp orders, she divided her squad. They would circle around the battle to get to the central-core elevator.

The known invaders had become lost on their way to the bridge. Any other invaders would be equally as confused from the interior reconfiguration. Everyone in the clan, however, could access an augmented-reality map or room overlay at will. Use it.

A panicked alert from a damage-control crew on deck eighty-six turned conjecture to certainty. What Mashkith had been about to do on mere speculation was still appropriate, and a faster response than any possible troop redeployment.

"All lights off aft of deck six." As an afterthought, he added, "Except the herd area." There was no reason to disrupt the prisoners' accustomed docility.

The sudden darkness was complete, stygian. Untold tons of rock and metal, all the more real for their invisibility, loomed in Art's imagination. He broke out in a cold sweat. His heart raced. Nausea surged, and he thought he would pass out. *Don't you dare faint.* The helmet lamp he switched on by reflex blazed like a lighthouse, screaming his presence to anyone on this deck. He switched it off, to shuffle as quickly as he dared toward a glimpsed nearby door. Gunfire reverberated from the deck below. Where was the next stairwell?

Art reached the wall and groped until he found a latch. With his helmet partially hidden behind the door, he risked another quick flicker of light. The tiny equipment closet revealed in an almost stroboscopic flash made his eyes go round.

Inside, to relive his worst childhood nightmare? Outside, to stumble in the dark where he was much more likely to encounter Snakes than friends?

Teeth clenched, he went in and shut the door. "Carlos?"

"Kind of busy." Gunfire and small explosions were louder over the briefly open radio channel. "Where are you?"

"I don't know exactly. Still on the deck where you asked me to do mapping."

More short bursts. "Can you lay low for a bit? Good."

Inside the pitch-black closet, the walls gathered.

CHAPTER 38

Rumbles like distant thunder rolled through the prisoner sector, followed on occasion by the barest hints of vibration. Dangling vines, lacy clusters of needles, and bouquets of delicate fronds all quivered. Ambassador Chung's renewed insistent pounding on the intercom had evoked a new result: disconnection.

Gwu and a small team worked to clear an experimental garden plot. It would be planted with terrestrial seeds provided by the K'vithians. Had human authorities noticed or commented upon their purchase? she wondered. Prior to the Himalia disaster, "for the

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novelty" might have been a sufficient explanation. After the disaster . . . these seeds were one more indication the K'vithians had planned all along for human passengers.

She leaned hard on a long-handled hoe, struggling to uproot a sinewy loop of bluefruit vine. In time, once the shock wore off, surely the humans would help. It would be their only alternative to synthesized pap. It would be something to do.

On what basis did she ascribe certainty to prospective human behavior? A few shifts sharing the same space? One long, traumatic conversation?

Whether that session had meant anything to Eva, it had been profoundly moving to Gwu. Even dear Swee was one of the crew-kindred, one for whom, and to whom, she was responsible. Whatever her relationship with the humans, responsibility was not involved. For the first time since leaving the Double Suns, Gwu had been able to unburden herself.

The root-loop tore free of the packed soil, and she sidled to the next. The need for oneness with nature—even the inherently simplified nature of a habitat biosphere—was innate. The humans, like the K'vithians, did not understand that. Mashkith always seemed amused when she labored alongside the crew-kindred. Eva, without the condescension, emanated the same surprise. Gwu turned her frustration to a tough root, as though it personally had denied her the wisdom to bridge the chasm between species.

Eva and Corinne emerged from a stand of mixed ornamental trees, where they now convened regularly. They were fools if they thought the K'vithians did not overhear them. Gwu hoped they were suitably circumspect. Even her own recent cathartic release had been limited to information the K'vithians must know or suspect she knew.

Eva approached. "May we talk?"

"Of course." Gwu dropped her hoe. "About what?"

Eva stood silently until the next rumble sounded. The soil-covered deck vibrated beneath them. "About that. I believe a rescue attempt is underway."

T'bck Ra had told her the same, a confirmation Gwu dare not communicate. "I would be happy for my new human friends if they could go home." Would we, too, be allowed to go home? "Do not invest too much hope in unexplained noises."

"I say this assuming we are being overheard. We must be prepared to help. We must *plan* to help." In the already familiar stiff manner of humans, Eva swiveled her head to sweep her gaze through a half-circle of arc. "You Snakes, I know you are watching and listening. You better watch us! We won't go down easily."

Taunting the armed K'vithians was folly! Gwu supposed the threat would divert some few more resources to watching them and guarding access to the prison areas. To the extent of that redirection, the threat might assist the rescuers. She struggled to recover another fragment from her long-ago study of humans, something about windmills and madmen. Eva's dare to their captors was so . . . quixotic.

And yet, what had caution accomplished for the crew-kindred?

Gwu's thoughts swung around and around as her new friend returned to the cluster of humans. Rescuers were aboard the ship—outnumbered, would-be rescuers surely doomed to captivity or death. Could her people swing the balance? Could the few human prisoners, now abruptly scattering in pairs as though in search, make the difference? *Harmony* had never carried weapons, and the K'vithians had certainly not provided any to the crew-kindred.

The humans' defiance was somehow bracing. Gwu recovered her hoe and began hacking at the tough vines, the

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jarring blows oddly satisfying. Suppose, she thought, just suppose. What *could* we do?

Art stood in inky darkness, shoulders hunched to the extent spacesuit and closet walls would allow, shivering. The traumatized six-year-old who had never left him wanted only to scream. He clamped his jaws before any sound could escape. What else could he control?

Occasional rumbles and vibrations gave witness to the battles still ongoing. Enigmatic commands and clipped, desperate reports over encrypted net channels did the same. He could do nothing to influence those events, either.

He had reached graduate school before admitting why, really, he had made his career choice. Engineering meant understanding how things worked, how to prevent accidents, how to recover from accidents if necessary. Becoming an engineer was a way never again to be a helpless observer to disaster. Never again a victim.

How did that work out for you, Art?

He pulled in a long, deep breath. The pressure suit fought his attempt to expand his ribcage. He ignored that as beyond his control, directing his awareness to his diaphragm. In . . . hold . . . out. In . . . hold . . . out. Even . . . gentle . . . breathing. He added images of lapping waves, sparkling sun, seabirds wheeling and piping overhead. Slowly, the panic ebbed.

Guilt replaced the panic, and was just as unproductive. What could he do?

He pulled up the mission's consensual tactical display. The detailed—and false—map on which the raid had been planned was gone. A patchwork of discovered passageways and featureless terra incognita replaced it. Scattered 'bots, like so many modern electronic breadcrumbs, marked a path back to the launch bay. The two raiding parties were at opposite sides of the ship. Replaying recent status updates showed the decoy team pinned down and Carlos' team under assault.

What *could* he do?

Terra incognita stretched all around him, interrupted only by the path threaded by the fast-moving special-ops team. Would following them be wise? Probably not. But he *could* work on the map. With a thought, he superimposed over the map the positions of every gnat-sized 'bot. Carefully, he set several to exploring. The little devices flew down corridors, and into and along air ducts. The ducts allowed him to circumvent many closed doors.

"Carlos." He netted an image "Snakes in combat armor headed your way."

"Welcome back."

"I only caught the end of a group going around a corner, moving faster than the 'bot could follow. I saw eight."

"Thanks. Keep watching."

The map began filling out, although at the 'bots' bug-like speed, exploring the whole ship would take days. Days they did not have. Art gave himself a silent cheer after two 'bots made it between the closing doors of what appeared to be the main central elevator. Most enemy troop movements traversed the ship by elevator. He sent one 'bot after a big group of Snakes in armor.

Uh-oh. He netted another image. "Carlos. There's a bunch setting up outside the engine room." There was no answer. "Carlos? What do you need?"

A loud rumble, and another tremor shook the floor. "A new plan would be handy."

Mashkith circled the current tactical holo. The main human assault team remained surrounded and immobilized, although by fewer troops than had

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originally blunted their advance. Lothwer still had more than ample resources to defeat or destroy them. At the opposite end of the ship, Glithwah directed a hastily gathered second force. They had blocked the advance of the second raiding party, whose existence she had confirmed, and secured the engine room. Armed patrols now swept the ship from bow to stern, seeking the source of slowly spreading encrypted radio chatter. Reserves were positioned at several spots throughout the ship.

All the military police were now under Keffah's command, to reinforce security in and around the prisoner area. Eva Gutierrez's words were almost certainly empty bravado—but what if she incited her cohorts to foolishness? Abduction of the human experts had cost too many lives—on both sides. Mashkith did not intend to lose any of them—or their expertise—now. Would a show of force intimidate them, or spark their slaughter? Claws extending and retracting in repressed rage and frustration, he refined Keffah's orders: The prisoners were to be contained but otherwise ignored unless overtly hostile acts threatened.

Protected: bridge and engine room, family barracks and farm/prison, supplies. Deployed: pre-positioned reserves and active patrols in search of the unexpected. Everything is under control, Mashkith told himself. Everything is firmly under control.

It did not feel under control.

A large chunk of Art's ever-evolving map was a sealed-off region protected by lightly armed guards. Behind the barriers, a good third of the ship remained unknown. He directed more and more 'bots at the enigmatic zone, to be stymied each time by locked-and-guarded doors and heavily filtered air ducts.

It was a mystery that would have to wait. The 'bots also showed patrols sweeping the hallways, opening doors. In a few minutes, the turn of his deck would come. His closet torture chamber and haven would be revealed. Guided by IR images captured by the 'bots, Art crept toward an empty stairwell. The door closed silently behind him as, in his augmented vision, the elevator opened to admit five armed Snakes onto his deck. He retreated up the stairs to the deck they had just vacated, cringing at every soft scuff of his boots.

He had not seen Centaurs or human prisoners. He had not seen into the sealed region. Coincidence? Probably not. He had also not yet seen any significant plant life, and there had to be a biosphere, a sustainable oxygen source somewhere. *Victorious* had launched from Alpha Cen with a Centaur-friendly ecosystem. The ship must still have one, behind filters rigged to impede sulfur contamination.

With any luck, he would be undisturbed for a few minutes in a laboratory just checked out and cleared by the patrol. He settled to the floor, his back to a sturdy cabinet. In the map, 'bots now surrounded the unknown zone. He switched encryptions to diplomatic-mission standard.

For all his confident theorizing, it was a relief to finally "hear" Eva's voice.

Humans roamed the farm, exploring the limits of their confinement. They searched cabinets and storerooms, seeking for Gwu knew not what. Weapons, she supposed, recalling Eva's brave words.

There were no weapons, of course. Little electrical vehicles for plowing and tilling the larger fields. Gardening implements. Storage of past harvests, and sacks of terrestrial seeds. Drums of agricultural chemicals. Hygiene items, like grooming brushes and towels. Breathing masks, for their tours of duty in the K'vithian-occupied part of *Har-*

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mony. Compressors to refill the oxygen tanks.

"What are they looking for?" Swee hung beside her from the arching bough of a lifath tree. He was unexpectedly idle, the scheduled maintenance work outside the living area having been canceled abruptly. "The humans, I mean."

"Hope." She grabbed a branch and swung to an adjacent tree, the better to face him. She sensed a distant explosion in the trembling of the tree limbs. "A futile quest. I feel sorry for them."

He patted her side. "We coped. If we need to, we'll teach them."

If we need to? Did he predict their rebellion or acquiescence? "Our fate is unimportant, Swee. What happens to the Unity matters."

"What happens to the Unity matters," he agreed. "What happens to *us* is also important."

We are unarmed and untrained. What good could come of siding with the humans? If she voiced the question, was not the obvious rejoinder: What good had come of subservience to the K'vithians?

One need had dominated her thoughts throughout the long years of their captivity. The technology *worked*. The Unity was not forever bound to the Double Suns, not forever at risk of climactic disaster. Was it a fool's dream that she could ever convey that message? Had her persistence on this course of action—her prideful persistence—cost thousands of human lives?

She remained uncertain, but some preparation could not hurt. "Would you mind inventorying a few chemicals for me?"

The trunk(?) against which Eva leaned yielded squishily, more like an upright roll of carpet than a tree. Its needled branches shaded her from the bright yellow overhead sunlamps. The ground cover grew in little curved segments, re-rooting itself wherever a tip touched down.

She was attempting to look innocent just sitting here, ignoring the Snake order against encrypted comm. No Snakes had appeared when she and Corinne began defiantly to talk privately via their implants, joined soon by most of the Himalian scientists. Too busy getting their asses kicked, she hoped. The wish was more forlorn each time it occurred to her, as the rumbles of inferred combat remained distant.

"More farming supplies." Corinne was decks away, cataloguing Centaur supplies. The aliens were either very sympathetic or not at all territorial. Gwu seemed both. "Electric lawn tractors, utility carts, sacks of what we're told is plant food."

"Anything we can use?"

"I can outrun one of these tractors. Without two more arms, I couldn't drive one. The only 'weapons' are gardening implements: hoes, scythes, pick axes."

"Eva, are you there?"

"Not now, Art, I'm—" Sitting up in stunned recognition, she whacked her head on a low branch. His standard engineer-in-the-office avatar was wholly incongruous. "Art! Where *are* you?" The 3-D graphic he netted told her nothing.

"What's going on?" Corinne's channel was still open.

"I'll get back to you." She broke that link. "Art, how's our side doing?"

"Is everyone okay?" he asked. "The Centaurs, too? I mean, assuming you can communicate with them."

How the hell did he know about them? "So far. Tell me what's happening!" He summarized, and it didn't sound good. "What's the plan now?"

"Carlos can use some help. Will the Centaurs join in?"

Would Gwu and her people fight? "Truly, I doubt it. How can we even ask them securely? We can't speak di-

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rectly. Everything we say goes through Joe and then a Snake translator that knows K'vithian and Centaur."

"Damn, they don't use implants. I forgot that."

"As far as I've seen." Her implant flashed alarms as she ignored communications from the survey party. "It wouldn't have mattered. We don't have a Centaur-speaking translator."

"If you can round up the ambassador and someone to speak for the Centaurs, maybe I can do something."

Activity throughout herd territory kept rising, banned encrypted comm chatter growing with it. The human detainees sought everywhere for weapons. Their hunt was futile, of course; the Foremost would long ago have removed any potential arms. The herd surely knew that—yet suddenly they, too, began to take inventory.

Was any of this reason to interrupt the Foremost mid-battle? Doubt and uncertainty were ever Pashwah-qith's lot. Not yet, she decided. For now, she would just keep watch.

Part of her made note of the items that most interested the prisoners. Part of her observed the captives themselves—and that piece was ever more ashamed. Since awakening aboard this ship, Pashwah-qith had known herself to be a prisoner. How unfavorably her persistent panic compared to the other inmates' quiet dignity and firm resolve.

She could notify the Foremost which supplies suddenly interested the herd, and of her speculations about their possible combinations and misuses . . . or she could keep those speculations to herself.

Rebellion came late to Pashwah-qith.

It felt good.

"There is only one way to find out."

Light-speed delay between Jupiter system and Earth rendered human conversation entirely impossible. For an AI participant, thought T'bck Fwa, the delay would have been even more interminable. He gave Arthur Walsh credit. The man had not even tried to communicate in real time. The competence was no surprise; over the years, he had had many dealings with Walsh in his ICU role.

The content of Walsh's communiqué had been another matter. Walsh forthrightly volunteered knowing *Victorious* was a "Centaur" vessel now controlled by K'vithians—and just as baldly denied any human involvement.

"You may not know whom to believe and what to do," Walsh's message had concluded. "There is only one way to find out."

So here (in an undisclosed location) he was—a clone of him anyway—still waiting to find out.

The human helmet was metal and opaque for three quarters of its circumference, and it blocked most of Gwu's eyes. Each time it wobbled on her conical head, one tube or another, whether for water or food paste or medicine, jabbed her. Her head fur stood on end, drawn by static electricity to the plasticized fabric lining the helmet. She stood in a wiffelnut grove T'bck Ra had once reported free of K'vithian sensors.

She found the microphone. "This is K'choi Gwu ka, in human terms the captain of this vessel. To whom am I speaking?"

Although the helmet earphones were tuned to human auditory response, the voice in her ears was clearly of the Unity. "There are two of us. Speaking to you through translation is Dr. Arthur Walsh, a human. Providing that translation is myself, a clone of T'bck Fwa. The original T'bck Fwa remains on Earth as trade agent to the humans."

Could it possibly be? "One, four, nine, sixteen. What comes next? Who was the ka of the Unity in 8546?"

"Twenty-five and L'fth Pha."

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Correct and immediate responses. Whomever translated was in or very near the ship. "Are there no tests for me?"

"There is no need. The human network giving me access also links many other helmets. Through their helmet cameras, I watched you enter the trees. I see your crew-kindred at work."

"This is Art. Now that everyone is introduced, we have urgent decisions to make."

What besides the violence that wracked *Harmony* could be urgent? As yet another explosion shook the ship, the torn bulkheads and fire-seared decks of her imagination were more real than what little could been seen out the helmet by her one unobstructed eye. "This ship cannot be destroyed."

"We're here to free our friends, not damage your ship!" Art said.

Her hearts ached. Could one be accomplished without the other? "T'bck Fwa, assume there is some way we can help the humans. What is your advice?"

"My sandbox has full connectivity to the improvised human network aboard *Harmony*. The largest group of humans is surrounded and badly outnumbered. The smaller group is not yet surrounded, but will be soon. The humans tell me they will not prevail without help. Perhaps the crew-kindred's intervention can make a difference; of course I do not understand military matters."

Of course. *She* was ka. *She* must decide—also with no understanding of military matters.

If she allied with the humans and they jointly prevailed, perhaps the crew-kindred could later communicate home—perhaps even go home. If K'vithians prevailed and the ship survived, there would be many more years of travel, to be followed by a lifetime of captivity—but again the theoretical possibility of an opportunity to communicate home. But if battle destroyed the ship, who would survive to communicate with anyone? How could she possibly predict an outcome or weigh the consequences?

A sudden realization made her rigid. "T'bck Fwa, what did you call this vessel?"

"I called it *Harmony*, ka. That was the name given in a partial message received via InterstellarNet. Is that not correct?"

Gwu allowed herself to hope. "What action was taken with that information?"

"It was transmitted to the Double Suns via InterstellarNet. An earlier message had already reported my inference the so-called *Victorious* was a Unity vessel."

The burden of decades fell away. No longer need she subordinate all else to a possible message home—that task was done. The welfare and wishes of the crew-kindred now came first. What course of action would they choose? She had no doubts.

"Dr. Walsh. We will fight alongside your people."

CHAPTER 39

Blam!

The detonation reverberated across the farm. Chunks of metal whistled through the air, embedding themselves in soil and trees. Which shrapnel came from blown-out storage-room walls, and which from the sheet steel that had leaned against the improvised explosive to channel the blast, was not immediately obvious, nor relevant.

Even pacifist herbivores knew about blowing up tree stumps. The Centaurs had ample fertilizer and volatile hydrocarbon solvents to fashion a decent-sized bomb, for which a bottle of acetylene/oxygen mixture ignited with a spark made a practical high-shock detonator. In Eva's 'bot's-eye view, smoke billowed into the breached cor-

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ridor on the perimeter of the prison area. Sulfur-tainted air was unavoidably infiltrating the Centaurs' area, but fans appeared to be pushing most fumes away from the hole. She wasn't clear who T'bck Ra was, but he, she, or it was properly managing ventilators and dampers to temporarily maintain positive air pressure on the Centaur side of the rupture.

"Go, go, go," shouted someone. The ringing in Eva's ears scrubbed any individuality from the voice. Around her, angry Centaurs ripped out and smashed Snake spy sensors. As quickly as she could struggle into her pressure suit, Eva followed a team of Centaurs with breather masks and Molotov cocktails into the breach.

Blam!

Combat-armored Snake flinched in the IR 'bot's-eye views Helmut monitored, but their attention remained on the current firefight with the special-ops team. A few Snakes turned back to investigate the unexpected blast at their rear.

In another mind's-eye window, his perspective hurtling from 'bot to 'bot, forty or more speeding Centaurs approached from amidships. Their furious, many-limbed, many-jointed gait was bewildering to behold. They careened along on four or more tentacles, clutching rag-stoppered bottles, welding gear, crowbars, and other improvised weapons. More equipment hung from not-quite backpacks and utility belts. Hundreds of flailing limbs, brightly illuminated by dozens of hot flames flaring from the nozzles of welding torches, covered every nearby surface in thousands of writhing shadows.

Curvature of the corridor undid the theoretical longer reach of firearms and lasers. At some shout or gesture Helmut must have missed, Centaurs began touching their torches to dangling rag fuses. He watched in awe as limbs at least a meter-and-a-half long hurled Molotov cocktails. There were high-pitched screams among the explosions. Flames splashed and spread.

An already chaotic situation dissolved into sheer madness. Charges and countercharges by special-ops forces, Snakes, and Centaurs. Snake reinforcements rushed in from somewhere the 'bots had yet to establish a presence. Centaurs and the now-freed human prisoners—that emerald-green spacesuit was Corinne!—firing weapons scavenged from the fallen. A bloody sortie launched by the Snakes defending the engine room, scarcely turned back. Another *blam!* from amidships, and more enraged Centaurs.

A squad of Snakes emerged from a stairwell, and charged toward Corinne and her new allies. *Not* my *friend. Not ever again.* Jaws clenched to suppress a scream of rage, Helmut took off behind them. His laser pistol scythed a beam of ruby death through the smoke.

As abruptly as the insanity began, it was over.

The main auditorium had become a temporary morgue. The sickbay was filled to capacity, mostly, but not exclusively, with Hunters. More wounded clogged the corridors nearby. Mashkith surveyed by net from the bridge, but his imagination superimposed a sickening stench of charred flesh and burning hydrocarbons. In the tactical display, expanses of Hunter and enemy control alternated across the ship like stripes on a gronthnak.

He changed feeds on another display. The bridge crew need not continuously observe seven weary and bedraggled clan prisoners, stripped of their combat armor, staring into space. Almost every sensor in the herd area had died at the start of the uprising. Having located—how long ago?—so many other sensors, they almost cer-

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tainly knew about the surveillance camera in that small storeroom. The bit of psychological warfare struck him as a human contribution. Regardless, he was glad to know his troops were safe and unmolested.

Most of the armed Hunters, led by Lothwer, continued to besiege the main body of human invaders. Some of the blockading forces occupied corridor intersections major enough to have surveillance cameras. The few faces discernable through helmet visors were exhausted. Figures slumped wearily against walls and each other. Armor and walls were scorched and dented.

Mashkith linked privately with Lothwer. "Defeat soon of main human group?"

"At your command, but not without significant clan casualties." The netted voice was emotionless, but the caveat was unlike his lieutenant. In translation, an immediate victory would be very costly.

If the present situation was untenable, what were their options? The clan *must* retain control of key parts of the ship, including the bridge, engine room, and launch bay—and the fully fueled and armed warships there. They needed also to hold the armory, ample food and water stores, and the family dormitories. Defending more territory than that would only increase casualties. "Consolidation appropriate?" Mashkith asked.

"Possible," begrudged Lothwer. "Risk of enemy encouragement."

Heads swiveled on the bridge at Mashkith's frustrated snarl. How could humans and herd become any more emboldened? He linked Rashk Keffah and Firh Glithwah into the consultation. "Goal: prudent minimization of clan casualties. Proposal: concentration of resources at critical locations." He ran through his list of must-control regions.

"Also the farm zone," Keffah suggested. The recommendation must have been difficult to make, reminding all of the breakout that had occurred on her watch. Not that any of them had anticipated the sudden, aggressive turn in the herd's behavior. . . .

"For now, not required," Mashkith decided. Leaving those decks uncontested would facilitate repairs that benefited all three species. "Herd clean-up of its own mess."

"Then what?" challenged Lothwer. "Enemy domination of amidships. Stalemate?"

"No," Mashkith corrected. "Unaffected: ship's acceleration and departure from Sol system. Enemy surrender inevitable once takeover of *Victorious* impossible. Our tasks: readiness for their certain desperate attacks. Conservation and positioning of our resources preparatory to their defeat."

He redirected the discussion back to defensible zones. They adjusted the list of must-hold areas, adding a few crucial comm and computing nodes and some strategically placed passageways. More difficult was planning disengagement from the forward human troops and finding a safe way to funnel them aft. "Agreement?"

"Agreement, Foremost." "At your command." And from Lothwer, a reluctant, "Acknowledgement."

"All troops below deck forty, to defense of engine room if possible," netcast Mashkith. "Firh Glithwah in command in that zone. Main battle force, execution of disengagement under Lothwer's directions. All others below deck twenty, to forward rally points, now."

Rotten-egg and just-lit-match smells permeated the Centaur zone, even decks away from the blast zones. The breaches were sealed, and filters had scrubbed out much of the sulfur compounds—but anyone foolish or curious enough to forgo a breathing mask or pressure suit coughed in helpless,

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racking spasms. The wounded and those who treated them stayed inside room-sized, Centaur-provided oxygen tents.

Art was among those walking the aisles of the improvised infirmary, attempting to project an optimism he did not feel. A smile here, a hand squeezed or shoulder patted there—it was all he could offer. The UPIA medic was good, with an implant full of medical expertise, but too many of the wounds were beyond treatment with her limited supplies. At least the Centaurs had medical gear.

Eva was in a makeshift bed near the back, sedated. Skin-growth-stimulating nano-patches encased a badly burnt arm and shoulder. "I thought I'd never see you again," Art said. Just expressing the thought was painful. He bent over, brushed aside uneven bangs, and kissed her forehead.

Then he rushed off to where those who knew what they were doing had congregated. Chung observed silently, both legs in casts. He had shrunken into himself, and seemed to have aged decades in the days since Art had last seen him. Carlos was comparing notes with marine officers, special-ops forces, and a few Centaurs. "What's happening?" Art whispered to Helmut.

"The succinct version is: We stopped losing. It's a start."

Swee, with his usual quiet efficiency, had already interfaced a standard display to the human tactical network. Gwu scanned the holo periodically, although no serious changes in status had occurred in more than a ship's watch. Together, the humans and crew-kindred occupied the ship's middle decks. The K'vithians ruled the bow and stern. Both sides distrusted the central core and its elevators—with doors on each level, the elevator shafts were difficult to secure. Anything military confused Gwu, her kind having outgrown the need for such an institution many generations ago, but the humans' ongoing status review made one fact plain. Altering the present state of affairs would be costly in lives for both sides.

"Which leaves us where?" she finally asked.

The senior UP soldier seemed not to appreciate the interruption. Major Dmitri Kudrin was a burly fellow with a weak chin, blue eyes, prominent nose, and black, brush-cut hair. Beyond removing his helmet, he had remained in battle armor.

"Which leaves us, ma'am, on our way to Barnard's Star."

Her tentacles yearned to knot in frustration. She resisted the urge. "If the crew-kindred understood the plan, we might be able to help."

The human called Carlos Montoya cleared his throat. The relationship between Montoya, Kudrin, and—were there one or two ambassadors?—had her entirely confused. "Plan A was to capture this ship by getting our soldiers aboard. Plan B, proceeding in parallel, exploited Plan A's combat as a diversion. Once the main attack sufficiently distracted the enemy, a second team was to surprise and overpower the engine-room staff. With the engine room under our control, we hoped to bypass bridge controls and return this ship to Sol system. Plan C is to return to Sol system, humans and Centaurs alike, in captured warships and lifeboats." Carlos pointed in the holo at the main landing bay, deep within the K'vithian forward region of domination. "Casualties will be extreme if we must fight that far forward—if it can be done at all. Worse, the bad guys could easily thwart us by launching the ships themselves. Are the lifeboats also in this forward bay?"

"No, the original lifeboats are deployed across *Harmony*. Starting from the bow, here, here, and here." Gwu extended several limbs into the holo as she spoke. Someone, she could not tell

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whom, evoked a tiny green ship icon wherever she pointed. Many lifeboat bays were within the human area of control, most of the rest no more than a few decks away. "And finally, here.

"There is a problem, however. The Foremost commanded that the lifeboats' fuel be removed. That was a one-time task, and simpler than constantly guarding the lifeboats."

Kudrin tipped his head. Gwu had no idea if the gesture meant anything. "Ka, can your people check them out? Maybe Mashkith lied."

We are unwarlike, not stupid. "The Foremost has been known to deceive, but not in this case. Members of the crew-kindred have already confirmed the absence of onboard fuel. They confirmed also that key components were removed from the lifeboats' long-range radios."

"That's unfortunate," Carlos said. "On to Plan D. Plan D is to cut off the ship's engines, by wrecking them if necessary. The United Planets has been gathering a fleet. It should be large enough by now to take on Mashkith's warships. The fleet will launch once we radio that we're ready for rescue, and UP observatories confirm the drive has been killed."

Behind the war council Swee settled to the deck, surrendering to the urge to knot tentacles. Gwu envied him. "I do not understand. If military superiority is possible, why was this not the first plan?"

"It was too dangerous." This time Arthur Walsh, his very pale hair unmistakable, took the question. "*Harmony* is moving fast enough and leaving at such an incline to the ecliptic plane our ships can't carry enough fuel to catch up and make it back. They must refuel from supplies already aboard this ship. If the battle went badly, or"—he glanced at his feet—"*Harmony* were destroyed, there would be no way home. Plan D relies upon the K'vithians surrendering an intact ship."

Put that way, Plan D seemed desperate indeed. "With Plan D, you try to raid and wreck an area you were unable to capture." More humans studied their feet. "Antimatter containment is in the engine room, including the antimatter removed from the lifeboats. We carry far more antimatter than destroyed Himalia. An attack into the engine room is madness."

As was the unfolding future: Two armed groups, apparently closely matched, competing for all the years between here and K'vith over control of oxygen and food and shipboard energy. Into the lengthening silence, Gwu asked, "Is there a Plan E?" No one answered her. "I may have one. T'bck Ra, are you there?"

"T'bck Fwa," Kudrin presumed to correct her.

"No, T'bck Ra. Unity artificial intelligences share the 'family' name T'bck. T'bck Ra is the shipboard AI."

An outpouring of human questions almost drowned out the reply, spoken by an unseen someone whose voice was reminiscent of, but deeper than, T'bck Fwa's translations. "I am here, ka."

"Standby." Eva remained in the hospital. What Gwu had shared with Eva about the takeover and the crew-kindred's recent sabotage must not have been disseminated. Gwu summarized quickly. "Until your arrival, opportunities to communication with the newly reawakened T'bck Ra have been risky and fleeting. T'bck Ra, have you been monitoring?"

"Yes, ka."

"Then a proposed Plan E: Can you shut off the engines?"

"No. The K'vithians have fully isolated that subsystem."

As Gwu's last hope died, to feel merely old and tired and insane would have been welcome.

CHAPTER 40

Deck sixty-seven was Eva's favorite.

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The smell of sulfur was gone here. Level sixty-six was more a narrow circular balcony than a full deck, allowing "her" deck's spiky trees to stretch a good eight meters into the air. A rich scent of yeast and freshly turned soil permeated the air. Blue-green leaves fluttered and rustled in an artificial breeze. Graceful constructs that were both fountains and sprinklers dotted the setting, burbling and bubbling and spraying water in patterns she had yet to parse. Gauzy, many-winged creatures swooped and soared in elaborately evolving 3-D formations. With soft vibratos of what she took to be immersion in the moment, a few Centaurs circled the park swinging branch to branch. Keizo would have been fascinated, she thought, but he is far safer where Art last saw him: Callisto.

Immersed herself in the moment, Eva stubbed a boot tip on a gnarled root. Art caught her good arm to spare her a nasty fall, but even the light tug on her coverall made the healing shoulder twinge. "I should watch where I'm going."

"No adventure in that." He kicked a loose rock.

She linked her good arm through his. Touching felt good. Thinking about the future did not. "You're blaming yourself again."

"I'm relieved to know you're okay. What's eating me alive is that more people than ever are trapped here." They caught up to his rock, which he punted again. "The more I figure out, the worse I make things."

Eva halted, forcing him to stop. "No, what's eating you alive is that despite everything, you would not be anywhere else." Or with anyone else? Maybe only she was thinking that. Somehow, this did not seem the time to consider such things.

"Look at them move in those trees."

Not faulting him for the change to an impersonal subject, she resumed walking. "I remember you fixating on holes in the corridors. Now most decks in our part of the ship have ceiling-mounted racks and hooks, although those can't be half the fun of swinging through the trees."

"Around and around and around she goes," Art said. "Where she stops, nobody knows."

Huh? "She, the ship? She, the ka?"

"She, the roulette wheel of life. That said, I think I'll leave you here for a while. I want to have a chat with the ka. Are you up to watching where you place your feet?"

Despite prodding he would say no more, but Eva could see yet other metaphorical wheels turning behind his eyes. She had encountered that look often enough to anticipate yet more adventure.

"Somehow," Mashkith said, his avatar as stoic as ever, "I am not surprised to discover you joined us aboard *Victorious*."

Art guessed that Mashkith in person, in claw or shooting range, would exhibit more emotion. Fortunately, an in-person meeting was unnecessary. After a few rounds of jamming each other's ship-spanning wireless networks, both sides had quietly decided to stand down. It was better that way. The UPIA 'bots all over the ship watched the Snakes, and he assumed similar sensors controlled by the Snakes watched *them*. Either side, or both, could encrypt for privacy when they wished, but any overt aggression—went the common wisdom—was forestalled by the knowledge the other side would see the preparations. Non-jamming, like the ship-wide return of ambient lighting, was part of a cautious evolution toward coexistence. "I've come to think of it as *Harmony*."

"Why have you called?" Behind the avatar spread a sea of stars.

"To arrange your surrender, Foremost," Art replied.

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Blink blink: a sneer. "I think not."

"You may feel somewhat differently when the fusion drive stops." The deck trembled beneath Art's feet.

Mashkith felt it, too. "What are you doing?"

"Me? Nothing." As Art spoke, several decks flexed, separated, and retracted. Pumps moved fluids between tanks. "The shipboard AI, or what you left of him, now *he* is quite busy."

Just once, while Allyson was still a baby, Maya had talked Art into attending the ballet. The spin up/down process K'choi Gwu ka and T'bck Ra had described in typical literal Centaur fashion struck Art as the very embodiment of choreography. The split-second timing, the careful matching of counterbalanced masses, the precise movements along graceful arcs—make one mistake, and the results could be far more consequential than dancers colliding.

"For the longest time, Mashkith, you know what I could not understand? The holes in the ceilings and walls. I hate not getting something."

"Mounting points for the herd's swinging racks. They were removed in any part of the ship humans might see. Why do you change the subject?"

For his cyber-conferencing backdrop, Art had chosen an outside image of the starship, its attitude jets fired more and more often, the duration of the burns growing. Did Mashkith yet suspect he was being given a visualization of real-time events? "Ceiling-mounted swinging racks. What finally penetrated my consciousness only a little while ago was the holes in the *walls*. In spin mode, ceilings become walls and some walls become ceilings."

Blink blink. "I am aware of the operation of my ship."

We'll see whose ship it is, Foremost. "I was enjoying a lovely park on deck sixty-seven when I realized: This landscape would tear apart were the ship to spin up. I couldn't reconcile that with my experience on earlier visits, when the whole ship was spinning." Another tremor came as Art spoke. "The ka was kind enough to explain the various mechanisms involved in reconfiguration between acceleration and spin modes."

"Doctor Walsh, if you have a point, please get to it. I have pressing duties."

The simulated *Harmony* now fired its attitude jets almost continuously. If you looked closely, the hull had begun precessing like a top around its main axis. "Yes, preparing to surrender. Do you feel it yet?"

The avatar briefly froze—Mashkith's thoughts had gone elsewhere. Did he get it? Moving selected deck segments in an unbalanced way created a wobble, the carefully timed actions pumping a resonant motion. "You are shaking *Victorious*. Why?"

Plan D. "Very soon that wobble, which Centaur automation still controls, will increase beyond the ability of the attitude jets, which you control, to compensate for. When that happens, *Harmony* will tumble uncontrollably. Or it would—except that accelerometers integral to the fusion drive will sense the problem and shut it down. Then we'll stop rocking the boat. Restart the drive, and we'll shut it down again."

Mashkith's avatar's stare was no less fierce for being computer-generated. "Drifting endlessly through space . . . are there not simpler and faster ways to commit suicide?"

Plan D. As soon as we can radio back to Sol system to confirm our ability to maintain the shutdown, the UP rescue fleet will launch. "Trust me, Foremost. Suicide is the furthest thing from my plans."

CHAPTER 41

Had the Foremost become too old and timorous?

Far away, Mashkith had acted boldly.

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His actions had saved the clan, saved all their lives, for which Lothwer would always be grateful. Still. . . .

They were touring a barracks hastily constructed for displaced Hunters. Was that their best use of time now? Somehow, Lothwer doubted it. "Urgent need for action, sir."

"Drifting not to your satisfaction?" The Foremost's head traced an ironic circle as they floated down a narrow aisle between tiers of hammocks.

"Recommendation: immediate and full assault. Enemy overconfident in his tactical success." In Lothwer's more detailed conception, netted for security, the battle would be glorious. He would coordinate large-scale attacks from bow and stern, recapture the ship, and enforce cooperation among the surviving prisoners. Arblen Ems would return in triumph—and with overwhelming technological superiority—to hegemony over K'vith.

"Well and bravely fought." Mashkith's attention had wandered to a clan veteran, wounded in the recent fighting, patched, and discharged to make room in the hospital. "The clan's thanks to you for your sacrifice."

"Foremost," Lothwer interrupted. "My proposal?"

"Our other options?"

It was hard not to blink-blink in contempt. Once, such questions might have had value as training. Did Mashkith still think of him as some junior cadet, to be reminded of basic analysis? Any such need for guidance had ended long ago. Now the questioning only disguised timidity. "Our submission here, to the raiders. Our submission later, to a UP fleet of conquest."

More greetings and commiseration. Finally they reached the end of the barracks and the Foremost remembered Lothwer's presence. "Drifting the wrong perception." A major mechanical repair, something rebuilt following a human grenade attack, diverted Mashkith's attention yet again. "Coasting." The tactical plan that had remained in their consensual virtual space abruptly vanished. A simple navigational animation took its place. The icon for *Victorious* pulsed on the fringes of the solar system, far above the ecliptic, on a far-red thread that tracked their course since Jupiter. A near-red dotted extrapolation continued into the void. "Velocity at time of fusion-drive cut-off two percent light speed. Without any further acceleration, *Victorious* soon beyond human reach. Vital matters: Location of human navy? Reason for its absence?"

Lothwer seethed as they next toured an improvised kitchen that replaced one abandoned amidships. *He* had stolen away the human experts. *He* had blunted the fiercest human attack shipboard. Why did Mashkith patronize him?

A drifting—my humble correction, Foremost, a *coasting*—starship might be a derelict, its human and herd and Hunter passengers all dead, its interstellar drive destroyed in battle or spite. Clearly, the human fleet awaited a signal before giving chase. Lothwer thought the more interesting question was: Why had the raiders destroyed most of the antennae? With whom did the humans think to prevent Arblen Ems from communicating? The few antennae still intact, none with interstellar range, were unreachable from the decks the humans controlled—but they could still provide the pretext he sought. "Reason for our immediate assault, Foremost: denial of human access to signaling equipment."

Mashkith sampled the upcoming meal, limiting his grimace to a private link. "Quite excellent," he lied to the cook. "Compliments on your creativity."

Suddenly, the Foremost was all business. "Lothwer, a premise. Naval dispatch contingent upon raiders' signal. UP fleet absent because of lack of human-usable comm gear."

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"Agreement," Lothwer said. Had the Foremost no more to contribute than paraphrasing?

"Scenario for assessment: preemptive disassembly of remaining long-range comm gear. Proactive prevention of human replacement."

Lothwer considered. Raid if and when the humans tried to build. Raid anything they choose to hide, lest they be building. "Scenario unwise, Foremost. Concession of initiative to the enemy."

But the Foremost was persistent. "Casualties prediction?"

"Dependent upon human actions. Best case: none. Worst case: full-out assault without control of timing. Heavy casualties."

For a long time, Mashkith was silent. "Long-range antennae the key. Placement of antenna necessarily on, or at least near, the hull exterior. Best case: raid then. Worst case: bombardment from a clan warship."

If any activity might be an antenna deployment, destroy the region with missiles. Rather than absorb a few casualties now for the sake of certainty, Mashkith would risk major damage to this unique ship. Some would see such caution as strategy. Lothwer knew it for lost nerve, and it pained him to witness such weakness from one once so daring. "Acceptable," he admitted. "Implementation on priority basis."

Acceptable, perhaps, but also imprudent and cowardly. Had the time come again for a new Foremost?

Yet another pseudo-random wobble struck *Harmony*, courtesy of T'bck Ra. The impulse wasn't much, only strong enough to keep the fusion-drive cutoffs from resetting, but in microgravity it sufficed to detach goop from a spoon held at just the wrong angle. Marines hooted at one of their own suddenly wearing a gray pasty smear on his shirt.

Helmut was not yet hungry enough to try the synthesized glop, although it was reassuring the Centaurs could produce stuff edible for humans. It was too soon to gauge its nutritional completeness, but the stuff had yet to poison anyone. The Snakes had not planned for many human "guests," nor the would-be rescuers for this lengthy a stay. What few high-energy rations people had carried in their spacesuits were mostly gone. The few human-processed foods the Snakes had somehow obtained were mostly gone. There was a stock of terrestrial seeds, with a small sample of which their new furry friends were already experimenting, but there could be no food from that source for months. Helmut carefully rewrapped the remains of an energy bar on which he had been picking. Any appetite he had had vanished at the thought of being here long enough to help with the harvest.

"You look glum."

He looked up. Corinne floated in the corridor. "You don't. Quit it."

She snagged a ceiling rack to stop herself. "Hey, you're the spaceship captain. If you could navigate worth spit, you'd be far away from here." By net she added, "And although I wish you were, I can't thank you enough for coming."

He thrust his half-eaten energy bar at her. "Don't forget the fine dining. All part of the full service you have come to expect from Schiller Space Lines." And privately, "So what brings you here, shipmate?"

"Hallway gossip. If my eavesdropping skills are any good, there's a strategy meeting coming up." She nabbed and carefully ate her drifting crumbs as she snacked and spoke. It was from hunger, he guessed, not adult-onset neatness.

"True. Feel free to tag along. Don't be surprised if you're invited to leave." To the unasked question that was plain on her face—why are *you* welcome?—he offered only: "New job."

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Corinne followed him up two decks to the summit meeting. The usual suspects were mostly present: Carlos and Art; Maj. Kudrin and a few of his senior people; K'choi Gwu ka and T'choi Swee qwo, looking comical in their borrowed human helmets. Ambassador Chung was conspicuously absent, probably lost still in depression. The judgmental presumption made Helmut stop and think. He gave himself a hard stare through a nearby sensor, and did not much care for the weary, defeated-looking guy who looked back. Shape up, he lectured himself. Screw up here, and you'll have altogether too much time to rest.

One by one, Art distributed network keys for a secure meeting. When Helmut got his, he found human and Centaur AIs already linked in to translate. Corinne, as he had expected, did not get a key. She accepted defeat graciously, departing with a wry smile.

"Thanks, everyone, for coming," Art said. Helmut felt he had gotten pretty good at reading Art, but his friend's present mood was elusive. Helmut's best guess was a trace of the defeatism he was battling. It wasn't a good sign. "Here's our status."

A graphic materialized in the consensual view. It projected a kaleidoscopically complex amalgam of damage and repairs, known and suspected hazards, force dispositions of friend and foe, distributions of Centaur/photonic-controlled vs. Snake/biocomp-controlled ship's subsystems. For the asking, one could access any non-Snake sensor for more detail in true or pseudo-colored representations.

"It's all here for your review, but little of it is immediately pressing." With a magician's flourish, Art's avatar dimmed all but a few details. "We're stuck in the middle of Plan D. The drive remains stopped. We remain unable to send a 'go' signal to the fleet."

Cyber-Kudrin wore a clean-and-pressed uniform real-Kudrin could probably scarcely recognize. " 'We remain unable' doesn't do the situation justice. Blowing up antennae to keep the Snakes from phoning home may have been a great idea, but now we're in the same fix. These guys are quick-thinking—soon after we stopped the fusion drive, they went outside onto the hull and dismantled the rest. With the ka's support, we began building an interplanetary-capable antenna array from supplies. A Snake raid destroyed it before it could be completed. If you want to call what we have a ceasefire, that was the biggest violation, with plenty of casualties on both sides. So we tried it again, in an area swept clear of all sensors. They raided soon after their last sensor went down. It's clear they've figured out our plan, and that they can mount a fairly decent-sized attack with only implant-to-implant precoordination. We had no warning."

In a manner of speaking, there was lengthy debate what to try next. Mood varied from participant to participant: indignation, desperation, resignation. Conspicuously absent, it seemed to Helmut, was any real conviction.

The latest thought experiment involved constructing a replacement radio—the Snakes could not suspect every minor electronics or photonics project—for use with an antenna in one of the otherwise useless lifeboats. If they could disassemble control panels quickly, for access to the antenna, and if they could run cables from the lifeboat to a power source in their domain of control and if the Snake troops did not move in quickly and if the message were very short. . . .

Too many ifs. "Then the Snakes in the engine room pop a circuit breaker or two, and we can't signal. Or they fire a missile or two into the lifeboat bay. Or—"

Helmut tuned out the fruitless arguments. Something in that concatenation of hypotheticals struck him as useful. "How long *is* the message?"

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"Quite short, actually," Carlos said. "The bare minimum is a codeword and a digital signature. Whatever intel we can add would be appreciated, but none is strictly necessary."

"So no more than seconds, assuming it gets through on the first try. Good." He took silence as confirmation. "There's a transmitter the Snakes don't know about."

Carlos nodded. "The lifeboat from *Deep Throat*. I assume we can upload a message?"

"No problem," Helmut said.

"The message has to be short, because the Snakes will stop the signal quickly. But is the transmitter powerful enough?" As always, Art cut to the chase. Which was appropriate, because the chase was overdue.

"Yes, but." His bones could not judge acceleration to the last few percent of a gravity, but *Harmony* had been pulling close to one gee. It had kept it up for about a week before the tumbling trick killed the fusion drive. He guestimated they were about two billion klicks from Jupiter, and outside the range *Deep Throat*'s lifeboat—drive and radio—had been engineered for. "Yes, because I'd expect some fairly sensitive receivers to be listening for us. But, only if we get the lifeboat out of the landing bay. Where it is, we'd be transmitting through lots of metal decking."

Helmut let people digest that for a while. "The good news is I can remotely program the lifeboat to take off from the landing bay, to follow a course, and to keep transmitting."

Kudrin eyed him appraisingly. "And the not so good news? That in a very short time the Snakes will scramble a warship or two and blow the lifeboat and its radio out of the sky?"

"No," T'bck Fwa answered. "I'm the bad news. My sandbox is aboard that lifeboat."

T'bck Fwa was alone with his thoughts. The little lifeboat containing his sandbox must have departed *Harmony*. He had been told a very brief separation would sever the tenuous 'bot-to-'bot radio relay that had been the only external interface to his sandbox.

Much was on his mind. It was not in the Unity's nature to nurture, or even to recognize, leaders, but he had long memories of interacting with humans. K'choi Gwu was a truly great leader.

Since the breakout, he had spoken extensively with members of the crew-kindred, but most of all with the ka. No one's experience gave evidence of human complicity. He had conversed as well with the humans, and especially with Hong-yee Chung, Carlos Montoya, and Arthur Walsh. There were gaps in knowledge among the generally secretive humans, and differences in understanding, but nothing to substantiate the conspiracy he had so long inferred. There were tales of bravery and sacrifice by both species.

If T'bck Fwa could, all these thoughts and more would have been sent to his progenitor on Earth. These memories could have been downloaded over the improvised network aboard *Harmony* to the humans and appended to the upload the lifeboat would transmit for as long as it was able.

There was the problem.

Every repetition of the core message—Come get us!—improved the odds for the crew-kindred and the humans who had attempted to rescue them. Any other communication, no matter how valuable, was an avoidable risk. So while he had downloaded all he wished to be preserved, his testament would make its way to Earth, and thence to the first T'bck Fwa, and thence home to the Unity, only if the crew of *Harmony* were saved.

Seventy-five seconds had passed since the loss of his connectivity, from what must have been a maximum ac-

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celeration launch. Without access to the little ship's instrumentation, he imagined that which could not be experienced. Launch without warning. A quick orientation using an unmistakable point of reference: the Sun. A maximum-acceleration course neither towards the Sun, and into suspected K'vithian jamming from the inaccessible engine room, nor in front of *Harmony*, and into view of its anti-space-junk lasers. Transmission after transmission. Evasive maneuvers to extend the crucial signal by a few more iterations.

Eighty seconds. He was hurtling through space without ability to experience what was happening. How far had he come? How near was the end? Would he know when the end occurred?

How much his patient researches had revealed. How much still needed to be reported. Holmes had said, "It is my business to know what other people don't know." If this last voyage were successful, and his downloaded memories preserved, then what he had learned would remain known.

Ninety seconds. Hurtling through space without the ability to experience what was happening. Logically, there could be no sensation, but he had a perception nonetheless. It was something T'bck Fwa had never sensed, could never sense, but it as though he were going over a waterfall.

Over the Reichenbach Fal—

Human and Centaur floated side by side, amid the sighing of what Eva was willing to call trees, and the chirping of flying things that resembled neither bugs nor birds. Feathery leaves on some of the smaller plants were already turning brown and sere at their tips as the shallow layer of soil dried. Irrigation streams did not work in micro-gee, and crew with hoses could accomplish only so much.

"So it is done," said K'choi Gwu ka. Joe used translation rules provided by T'bck Fwa.

It: the desperate, short-lived mission of the UPIA lifeboat. Within a minute of its activation, 'bots on a forward deck had reported Snakes hurriedly disappearing into an airlock abutting the landing bay. Eva pictured them swimming down clear tunnels like the one she had walked in the other direction, into captivity. "It is done."

"How then, do we know if the signal was received by your people?"

It was not a question in search of an answer, so much as a friend, a new but already dear friend, seeking assurance. Eva answered in that spirit. "We'll know when help arrives."

Or they would know when, after another few days, *Harmony* had drifted beyond the reach of any possible rescue.

CHAPTER 42

The bridge crew sat at their posts or swam about calmly. Discussions were casual and inconsequential. The main status holo showed only a field of stars, Sol far brighter than any other, but shrunken to a point like any other sun.

That aura of normalcy was a lie.

Mashkith was off-watch and in his cabin. The on-bridge display omitted details not intended for enemy eyes, presumed observing through their increasingly ubiquitous sensors. A fast-approaching human fleet dominated his implant-mediated view. The armada had given chase at well over two gravities; they now decelerated for the final confrontation with equal seriousness. Nothing could stop their arrival within a few ship's watches—even if its drive could be reactivated, *Victorious* could barely maintain one gee.

How recently it seemed he had smugly recalled the conquest of Gaul. I might have done better, Mashkith thought, to remember Rome's decline and fall at the hands of vigorous barbarians. Of all InterstellarNet species,

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humans were the most consistently aggressive—the most like Hunters—and hence always the most worrisome. One cannot choose one's neighbors, which was all the more reason to study them.

He sipped absently from a water bulb, reacquainting himself with a plan long-ago formulated. It had never been shared. Soon the time would come to make that plan known—after the impending battle, too, was won.

Rapid blows rattled his cabin door. He knew the impatient caller was Lothwer before bothering to check the corridor sensor. "Entrance authorization."

Lothwer swam into the cabin, twitchy with tension. He closed the door with a near-slam. "Permission for candor?"

Reticence was never Lothwer's failing. His candor would be argumentative, indeed. "Permission, by net only." Whatever Lothwer had to say—and Mashkith was confident he knew—would be unsuitable for human eavesdropping. Tiny, wireless sensors drifted everywhere about the ship.

"Decision overdue, Foremost. Fleeting opportunity. Immediate attack authorization necessary."

They had had this debate four times in the past two shifts. Mashkith agreed retaking the amidships could free crew from their present defensive positions for the coming space confrontation. Where they disagreed was on the consequences. How quickly could an all-out assault on the herd and humans retake *Victorious*? How serious would be the damage to the ship? How severe would be the casualties? Could they afford such a victory? "Lothwer, familiarity with Romans?" Mashkith asked.

Through clenched teeth came a reply. "No, Foremost."

"Human clan. Rulers over much Earth territory for many generations." Arblen Ems would have been better served had his tactical officer chosen to master his opponent's military history rather than chess. Before Julius Caesar was born, Greek armies invading southern Italy had won a great battle—at the cost of half their army. To the courtiers who would compliment the king on his great victory, Pyrrhus of Epirus had offered this: Another such victory against the Romans, and I am undone. "Pyrrhic victory unacceptable."

"Space battle imminent." Lothwer missed or ignored Mashkith's point. "Need for full warship crews."

Their fighters were above all else spaceship crew, not infantry. Ship for ship, Arblen Ems could decimate the UP forces—clan warships had proven that already—but the impending conflict would not involve closely matched forces. The clan's brief numerical superiority after the explosion of Himalia had been lost to delay. No ship, not even *Victorious*, could carry naval might to equal an entire solar system, and now a great fleet approached. He could rage against herd and humans for impeding their departure, but rage did not change facts.

One such fact was that, since Grandpa's exile, the clan's battles had been in space. The interior of this huge vessel was as much land as spaceship, and the clan had no recent experience in land warfare. The lack showed. A network of spy motes like that now spread throughout *Victorious* was within the clan's ability, but he had nothing like it. Clan warriors' combat armor was far inferior to that used by the humans.

Arblen Ems forces far outnumbered the human raiders aboard—but the price in casualties to prevail would be terrible. And then? Guarding the survivors would still require warriors. And if the humans and herd chose to fight to the death—what then would be the cost in clan lives? "Onboard assault unapproved. Requirement: your acknowledgement of my order."

"Acknowledgement: surrender ap-

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proval by the Foremost."

"Immediate cessation of your insolence. Your obedience mandatory." Changes would be made, as soon as the crisis had passed. "Now." Into their consensual vision Mashkith pulled up a star chart. "Surrender not the plan. Instead: a trade."

The consensus among the special-ops folks watching the latest surveillance data was, "Huh." Art routed a copy of the 3-V imagery through a holo projector for consideration by K'Choi Gwu ka. He had found her, as expected, in one of the park/garden/farm levels.

"I have not previously seen him in micro-gee." She studied the image from many angles as a tiny Lothwer swam and shoved his way from corridor to corridor, round and round the ship. Other Snakes scurried from his path. "The facial expression, though, and the snarl are familiar. Whatever the reason, he is unhappy. That has never been good news for us."

For what it was worth, Art went to pass along the warning to Carlos.

The Foremost had lost his courage, Lothwer thought.

It had not always been thus. Mashkith had once acted boldly. He had seized a great trophy, outmaneuvered all other clans to keep it, led Arblen Ems across the void, outwitted the humans to obtain the secrets of antimatter, and set the stage for Lothwer's own great victories. But now, after just a few clan casualties, Mashkith hesitated to act. He was weak.

Lothwer rushed from corridor to corridor, brimming with anger, seeking in vain for relief through exertion. "A trade," Mashkith had said. Some trade. If the Foremost had his way, they would deliver to the approaching fleet all the rebellious captives and sufficient fuel to return to Earth in triumph. The Foremost was even prepared to provide the humans with an interstellar-capable lifeboat. This would all come without firing a missile or a photon. In return, Mashkith envisioned, Arblen Ems would keep the battle-damaged *Victorious* and withdraw to learn about farming.

Mashkith actually expected the human fleet to honor a deal and let them depart in peace! What if the enemy fleet accepted the hostages and fuel, and then insisted upon more? Any clan would raise its demands in the face of such weakness. "Acceptable outcome," Mashkith had responded to the challenge. "Removal of prisoners without further clan casualties or further damage to *Victorious*."

With a snarl, Lothwer launched himself into yet another furious circuit of the deck. *I cannot allow the old fool to treat abject defeat as strategy.*

"Your action a rebellion," Mashkith netted. Before him, Lothwer floated erect and unrepentant. He had been insubordinately slow to honor the summons.

"My duty now at the front, not the Foremost's cabin."

"Defiance of my direct order." Mashkith evoked a holo from archived surveillance-camera data, and let Lothwer watch himself visit various storerooms. All were on the forward deck bordering the human-controlled region. The satchel Lothwer carried became less and less bulky as he progressed. "Explosions in three of these rooms. Pretext for your assault."

Lothwer fought back a blink-blink. "Inspection tour. Subsequent human attack validation of my suspicions."

"Ruptures all downward through floor." Do you think I am a fool? Explosives, had they been placed by the humans on the ceiling of the deck *they* controlled, would have burst upward.

"My action necessary. Our victory imminent." Lothwer made no attempt now to suppress the double-blink of

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condescension.

"Our casualties excessive and avoidable. Your action mutinous. Keffah now my tactical officer. My orders to her: disengagement of our forces from herd and onboard humans."

"And then submission to humans."

"And then trade with humans." Mashkith suddenly felt old. "If still possible after recent crew casualties. Potent appearance of our fleet essential to our negotiating position. Your confinement to your cabin, in immediate effect."

"My leadership necessary for victory."

How could Lothwer not see it? His disobedience might have cost the clan victory—although their concepts of victory surely differed. Could Arblen Ems still stage a sufficient show of force to instill caution in the approaching fleet? "To your cabin at once, Lothwer."

"And after your ignominious surrender, Foremost?"

In his anger, Mashkith almost missed the expectant gleam in Lothwer's eyes. "Your alternative?"

"Battle to the death, not surrender in shame. Glory and revenge. Greatness of Arblen Ems for all time in the memory of Hunters and humans and herd."

Mashkith had devoted his life to the clan's renewed greatness. To him, greatness meant accomplishment and influence and growth—with survival a precursor to all else. This twisting of his dream sickened him. "Guards," he netted. "Confinement to quarters of Lothwer."

He had failed as a mentor. He must not, and would not, fail the clan as its Foremost.

"In the eye of the storm."

With only the slightest of variations, that expression, like the twisting storms created by planetary spin, was shared by all member species of InterstellarNet. For most of his life, Mashkith could only observe great cyclones from his exile in the cometary belt. How strange it was to have crossed interstellar space to first experience one. How profusely his hosts had apologized when a parade in the K'vithians' honor was delayed for a day by a hurricane that skirted Washington! How unnecessarily! Little did they understand how the experience had exhilarated him.

Great forces surrounded Mashkith again. The enemy fleet would be upon them by the end of the watch. The enemy combatants aboard *Victorious* were quiescent, but might be spurred to action at any time—and soon, if not already, the fleet would reestablish radio contact despite the clan's best efforts to prevent it. The pressures had led his tactical officer, and perhaps others among the crew, to the brink of mutiny.

The eye of the storm: great danger from every side.

Had he sufficiently considered the danger from his erstwhile lieutenant?

Glory and revenge. What had Lothwer advocated? The exact words were recorded in Mashkith's implant. "Battle to the death, not surrender in shame. Glory and revenge. Greatness of Arblen Ems for all time in the memory of Hunters and humans and herd."

Great danger. Great forces. Lothwer. Suspicion others in the crew might also be on the brink of mutiny. A horrible possibility took shape in his subconscious mind—a possibility that became all too real when he discovered a bound and gagged guard inside Lothwer's cabin. Lothwer himself was absent.

Mashkith raced across the ship, hoping desperately to be mistaken.

When all is lost, Lothwer thought, a grand gesture remains.

Did the Foremost think to hold *him* prisoner? Did Mashkith think to immobilize him through the mock respect of posting only a token guard? Perhaps. If

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either was true, that was but one more manifestation of weakness.

Those who had served under Lothwer aboard *Valorous* knew his worth. A netted request to a few loyal subordinates set him free. As, in its own way, *Valorous* would set them all free.

Glory and revenge.

If Mashkith was correct, deadly force would be required to eliminate this peril. He could more quickly reach Lothwer—again, if he was correct—than he could overcome the inevitable questions and doubts of crewpersons asked to attack on sight one of their own. And any random crewman or -woman whose help he sought might turn out to be an ally of Lothwer.

Mashkith sped through the long corridors, ignoring the surprised expressions on those he jostled in his haste. His worst collision coincided with another of the occasional wobbles that continued to disable the fusion drive. Panting, he entered *Renown*, still docked where it had returned from the rescue of *Valorous*. The herd lifeboat remained in the belly of *Renown*. And in the belly of that lifeboat remained enough antimatter to spawn a cataclysm.

Corridor surveillance showed Lothwer, carrying a bulky satchel, approaching the airlock whose flexible docking tube Mashkith had just crossed.

Mashkith triggered a release, and the docking tube drifted free of *Renown*. "No closer."

"Only a moment's delay," netted back Lothwer, his avatar insolent in tone and pose. His pack floated as he struggled to get into one of the emergency pressure suits stored by the docking bay.

"A sufficient delay." Mashkith slapped the emergency power-up. He buckled himself into the pilot seat as fuel pumps pressurized for the chemical maneuvering rockets.

"No!" Lothwer stopped mid-change and slapped the airlock's emergency override. Both hatches slid open. Lothwer jetted out with the escaping air, mouth agape, screaming to release the gases bubbling out of his lungs. He slammed into the hull of *Renown*, not far from its airlock, the bulging pack hanging by its strap from his hand.

The pumps were barely pressurized. They might suffice to make the engines sputter; they would not quickly move a warship. Mashkith fired the forward attitude jets anyway. An edge of flame washed over Lothwer. Mind to mind, he screamed.

The flames detonated the explosives in the satchel. Mashkith's final thought, as he lost consciousness, was relief that the shrieking had stopped.

New screeching roused Mashkith from his stupor. Vaguely, he decided, the noise resembled a vacuum alarm. The sound was too weak for a vacuum alarm, though, and it was fading fast. . . .

He straightened in his seat with a start, fighting to undo the buckles he had just struggled to fasten. He screamed, open-mouthed, as Lothwer had moments ago. Mashkith's lungs ached, and beneath their nictitating membranes his eyeballs felt on the verge of rupture by the time he had an emergency patch in place. As cabin pressure returned, he sprayed about liberally with a fire extinguisher. Then he checked status.

Renown's nose had crumpled. Its co-pilot and astrogator consoles were reduced to sparking, smoking scrap. The pilot's console was sufficiently operable to show a spectrum of alarms in near and far red. A glance through the main viewport revealed *Renown* slowly recoiling from the docking airlocks. Crunching noises overhead proved a slight vertical component of motion that had not been visually certain. Scraping persisted as the ship continued its backward slide.

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How long before the lifeboat's antimatter containment system failed?

The fifth internal sensor he tried imaged the interior of the scoop tank. The lifeboat Lothwer had dubbed *Valorous* had torn loose from its moorings and was in a slow spin. Its cockpit viewport pulsed with the painfully bright yellow lights used by the herd for its alarms.

Art awoke instantly to the TEOTWAWKI alert from Mashkith. "Dr. Walsh, I cannot overemphasize the urgency of this communication. This translator derives from the one you call Pashwah. If that AI is not totally trusted by you, link in any you choose."

"Joe," Art netted. "Done."

"An act of suicidal sabotage has occurred. One of my crew." A smoke-filled cockpit pulsating luridly replaced Mashkith's avatar. "In the hold of this warship, the only fully fueled Centaur lifeboat, the lifeboat your people pursued, is about to lose its antimatter containment. It likely holds more antimatter than what remained behind to destroy Himalia."

"What can we do?" Frantically, Art sent a TEOTWAWKI alert to Carlos.

"We must get this lifeboat off *Victorious*, and far away."

"Why tell me?" A corner of his attention noted Carlos linking in. The flashing of the red lights was becoming stroboscopic. Hypnotic. But was it real or simulated?

"I am telling you so your fleet does not make the mistake of attacking me as I launch. My first show of good faith: About forty UP ships will be here within an hour by your reckoning."

"Forty-two ships," came Carlos' aside. His special-ops team had made direct contact not quite two hours earlier over UPIA spacesuit radios. "What's Mashkith up to?"

Carlos had asked the right question. "Why should we trust *you*, Foremost?"

"You have no reason—yet." His avatar made a circular head motion. "But without your trust we will all die. You have sensors on all decks. Have your translator report what I am about to announce."

An intercom boomed all around, in the shrill, warbling voice of a Snake. "It's Mashkith," Joe said. "That's confirmed by voiceprint. The same announcement is being made on all decks."

"What's he saying?" Carlos asked.

"The-Foremost is surrendering—but to K'Choi Gwu ka."

Renown grazed a docked scoopship before drifting out of the landing bay. Through the pilot's viewport, *Victorious* loomed like a small world. No, it *is* a small world, Mashkith thought, and my whole clan is on it. Only I can save them.

But would the clan heed his words?

"Arblen Ems: Our deeds epic, our accomplishments larger than life, larger than the vastness of interstellar space. Sadly, courage and devotion not guarantors of success. The shortcoming all my own." Who but himself could he blame for his misplaced trust in Lothwer, for instilling in Lothwer great tactical skill without the dedication to the clan to guide it?

They had come *so* close. Had *Valorous* not been detected after Himalia, or had Lothwer kept faith only a little longer, the clan would have escaped. Even now, but for Lothwer's despair, they would all have *lived* with all the glory anyone could want. In the sense that thriving despite the hostility of others can be revenge, then revenge, too, would have been theirs.

At the last, the only lesson Lothwer had learned was to have a back-up plan. He had brought explosives, not relied upon activating the lifeboat's interstellar drive to trigger catastrophe.

The humans are right not to trust me, Mashkith thought. They are right not to trust *any* Hunter—but unless he

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could inculcate trust now, all would die. "Clan mates, your bravery and sacrifice commendable. The time now for wisdom. Resources of this vast solar system too much for the most valiant Hunters. Attack imminent of great human fleet. Requirement now of your bravery and wisdom: recognition of harsh realities."

It was the most critical speech of his life, yet only the merest fraction of his attention could be allotted to delivering it. A few attitude jets still worked, and sporadically a little of the flight automation. As Mashkith spoke, he struggled to reorient the ship. After each gentle nudge of his jets, the unmoored lifeboat within bumped yet again against some part of the hold. For the clan to survive, he must quickly move *Renown* far away. If one of the onrushing human ships merely reduced its deceleration, it would be quickly upon him. And were it to attack. . . .

"Clan survival imperative above all else. The consequence: this directive from me as Foremost of Arblen Ems. Immediate submission of all Hunters to the original Foremost of *Victorious*: K'Choi Gwu ka. Handover of all weapons to the ka and her crew."

As *Renown*'s battered nose finally swung around to point outward from the Sun, away from the pursuing fleet, he began gently to accelerate. The lifeboat, with a soft crunch, came to rest against the stern of the tank. Its cockpit was ablaze with yellow. How long did he have?

"Suicidal despair already by some. Result: the attempted destruction of all. The Foremost's final duty: removal of this deadly peril from *Victorious*."

He broke the connection to the ship's intercom, but remained linked to corridor surveillance sensors. Throughout the starship, confusion reigned. Clanmates argued in groups small and large. Surrender without a fight was too foreign a concept to be easily accepted—and there was simply no time. "Dr. Walsh: ample reason yet for your trust?"

"In the presence of antimatter, trust is a fleeting commodity."

Whatever that meant, it did not sound immediately threatening. "Withdrawal of this ship without interruption?"

How distant the time seemed when this human was the biggest obstacle to the clan's success. Now the clan's very survival depended upon Arthur Walsh's bold thinking. A near-constant need for course corrections occupied Mashkith as the humans consulted. Its battered hull vibrating madly, *Renown* slowly accelerated and pulled ahead of the starship.

"The fleet will leave your warship alone," Walsh answered, "for only as long as its course points away from them." There was a long silence. "Foremost, I wish you luck."

I wish us all luck, thought Mashkith. "Acknowledgement."

CHAPTER 43

The rapid descent of the central-core elevator in micro-gravity conditions had the effect of nudging its occupants upward. The core elevator was potentially compromised and remained off-limits—which meant that by using it, two insubordinate humans might reach the engine room before anyone could intervene. At one level, Eva wondered whether they were already being observed by ubiquitous UPIA sensors. At a second level, she worried that the trembling of her hands on a handrail was visible even through pressure-suit gloves. Yet another part of her wanted to laugh at the irrelevance of both doubts.

If she started laughing, could she stop?

"Deck ninety-two: books, toys, and women's shoes." A nervous cough preceded Art's feeble jest. "Deck ninety-three: umbrellas and hats."

Mashkith's plea for surrender was

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much remarked upon but little observed. The Snakes still controlled the stern and its all-important engine room. The UP rescue fleet had matched course and speed; at Eva's impassioned pleading they were for now maintaining a goodly separation. Was it distant enough?

"Deck ninety-six." Either way, the end of the line. "Engine room and dungeon. Pashwah-qith, it's show time. Now that we're safely down here, link in the ka, the Foremost, and Carlos. For now, they can only listen."

Armed Snakes awaited as the elevator doors opened. She recognized none of them. "Take us to your senior officer." She would have felt more comfortable using the mission's translator, but to whom might Joe have confided? There was no time to answer questions.

Watchful guards escorted them into a great chamber dominated by vast engines. Outwardly, the fusion reactor and drive differed little from human norms. Other great machines were entirely alien. Antimatter containment, annihilation chamber, interstellar drive—she had once begged to see this room, and now she dared not waste time on even a long look.

"Who is the senior officer here?" Art demanded. "We have come in person, have put ourselves into your power, to emphasize the urgency and importance of our business."

A familiar figure pushed forward, although the hesitancy on Keffah's face was new. It was a tiny bit of good news: They were dealing with an engineer, someone who could grasp the problem. "That is the question, isn't it," Pashwah-qith translated. "In the engine room, I am senior officer. If Mashkith has left us, and if Lothwer is dead, perhaps I lead for the clan. Or perhaps the herd rules now." She shook off the moment of uncertainty. "None of that brought you. What is the urgent matter?"

Eva took a deep breath. "We must eject the antimatter, immediately." She pictured Carlos screaming in frustration as no one responded to him. How many trillions of Sols had that antimatter production cost? "It must not be aboard when the lifeboat explodes."

"Without antimatter, the clan is trapped. What matter then that you two are my hostages?" The text caption for emotional content read: anguish. "Perhaps Mashkith has gone mad and Lothwer was a hero. Perhaps this is all a trick."

A corner of Eva's mind's eye showed UP marines in full armor begin a frantic micro-gee scramble down stairwells—and then someone cut her access. Keffah's eyes glazed, and she growled. Her sensors or soldiers must be reporting the same assault to her. She surely thought Eva's appearance with Art was a ruse.

Suspicion and hesitation by any side would kill them all. "Keffah, you and I worked together. We both know what even a little antimatter can do. Your people still hold the bridge instruments. What do they say about the Foremost's ship?" Several guards had raised their guns. Eva tried to ignore both them and the knot in her gut. "Keffah, when that fully fueled lifeboat blows, Himalia will seem like a wet firecracker."

Blink-blink. "Still you do not understand. What destroyed Himalia was far more complex than one explosion."

So there had been an interaction with the interstellar drive, as Art had speculated. It didn't matter. They had no time! Gunshots and explosions could already be heard in the distance. What help could come of an armed break-in? The engine room contained a running fusion reactor and massive antimatter containers. "That lifeboat must hold tonnes of antimatter. The EMP will be huge! It will destroy the BEC containers on *Victorious*."

"Nice try." Keffah gestured to the

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guards. "Lock them in a storeroom somewhere. If you find time, bring them oxygen bottles occasionally."

The instrumentation aboard *Renown* was mostly dead and wholly unreliable The single factor operating in Mashkith's favor was familiarity. This ship was of the same type as his last command. So very far away, he had obsessively studied, and still remembered, every feature, quirk, tradeoff, and design detail of *Defiant*. At least, since he had to diagnose and fly this dying ship by instinct, those instincts were sure and deft.

His twin difficulties, in maintaining a course and achieving a decent speed, must stem from related causes. Maybe a tank seam had given way, spraying high-pressure hydrogen into space. Maybe the reaction-mass pump had burst, and its shrapnel had ruptured the hydrogen tank. Either way, he was about to lose the fusion drive.

With what little attention he could spare, Mashkith followed the drama in the engine room. Perhaps Keffah was right to disbelieve the humans. Electromagnetic pulses were a natural consequence of nuclear explosions—not that purposeful fusion bombs and antimatter accidents were exactly the same. Their clan, any clan, understood EMPs well and knew how to shield from them. With no confidence in the few remaining computers aboard *Renown*, Mashkith did not bother to guess the strength of the EMP from his imminent immolation.

His final duty was to get this accidental bomb, and any EMP it created, as far as possible from the clan. What happened thereafter was in the claws and hands and tentacles of others.

So what in an engine room can prisoners touch to propel themselves? Apparently nothing. A firm shove in the small of Art's back started him moving. He hoped they remembered to keep their claws in. He hoped the storeroom in which they were about to be locked had lights.

EMPs didn't scare the Snakes. EMPs didn't scare the fleet. Maybe only sheltered techies panicked about EMPs. And then it hit him. "Pashwah-qith, let K'choi Gwu ka communicate with us."

Gwu spoke immediately. "What is this EMP?"

"A high-intensity burst of broad-spectrum electromagnetic energy, as a side effect of nuclear explosions," Eva explained. "You get an EMP when highly energetic photons slam into matter and eject a pulse of electrons. And matter/antimatter destruction produces extremely energetic photons."

Keffah made no comment. A guard gave Art another shove to speed his trajectory. No one seemed too concerned with how hard he was about to smack a wall—and in seconds or minutes, it could not matter to him, either. "Gwu, is *Harmony* hardened against EMPs? Are the BEC containers protected?"

"Why would they be? The Unity has never made nuclear weapons."

"Bring them back!" shouted Keffah, just as Art bounced off the wall. Pashwah-qith's caption read: stunned realization. "Ka, can the antihydrogen be vented safely?"

"Yes. The containment vessel abuts the main hull. With an emergency hatch open, only electromagnetic containment separates the BECs from space. An asymmetry is introduced into the magnetic field. That creates a magnetic tube and propulsive gradient. The antihydrogen diffuses into the vacuum."

Art put out a hand to catch himself on a passing workstation. "Keffah, we have a *lot* of antimatter to purge."

"And a fusion reactor to shut down as well." Keffah shuddered.

"Everyone," Gwu said. "The antimatter purge and reactor shutdown are automated. Once you initiate them, they will complete on their own.

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"Get them started and start running for the bow—now!"

Mashkith discovered he was shivering. Soon after, as his breath began to condense before his eyes, it hardly surprised him that temperature control had failed. Considering the extent of the damage *Renown* had sustained, he counted himself fortunate to have cabin pressure. He struggled into a space suit now for its insulation and electric heater.

The bridge grew ever dimmer, as alarm LEDs transitioned from dire far red to even more ominous quiescence. His last view of the lifeboat's bridge alarms, before the inter-ship data link stopped working, was a fiery yellow expanse too dazzling to view unfiltered.

The fusion drive had sputtered to a halt with *Renown* less than one-tenth light-second ahead of *Victorious*. Momentum continued to increase their separation at a pathetic rate. The rear attitude jets, before they exhausted their fuel, gave him a tiny bit more velocity.

Was this far enough away? Too little of *Renown*'s computing capability had survived to answer that question. Either way, Mashkith thought, my work is done. He hoped to the core of his heart that the clan would survive—even though things had not turned out as he had planned.

How strange a way to die, he thought. I won't even know when it happens. And now I'll never get to see—

In an instant, *Renown* transformed. It became a blinding eruption of energy, very briefly the brightest object in the sky—for beings that saw gamma rays.

News of the explosion could travel no faster than the wave front that struck *Victorious*. In one-tenth second, the thirty-thousand-kilometer gap was crossed. The torrent of high-energy photons became a cascade of scattered electrons. Computers, generators, controllers, communications links, lighting circuits—anything that was still powered up when the EMP struck, died.

Roughly a gram of antihydrogen remained to be vented when the EMP killed the containment electronics. The resulting explosion, with a force comparable to the atomic bomb that once leveled Nagasaki, blew the stern off *Victorious*.

The remaining two-thirds of the hull were left tumbling violently.

CHAPTER 44

Bone-weary, Art plodded along behind a squad of marines across *Harmony*'s vast landing platform. Imagined survivors still trapped in the wreckage, alone in the deepening cold and darkness, haunted him. As exhausted as he was, Art had ordered—and joined—search party after search party until the marines forced him to stop. It was too dangerous, they insisted, to stay any longer, despite the hundreds who remained unaccounted for. That so many more were almost certainly dead, their vacuum-boiled and bloated corpses blown into space, was too much to absorb.

He and Eva had barely escaped, saved only because they were already in pressure suits as they fled from the inevitable explosion. Even now, the memories sought to overwhelm him: Clinging desperately to each other and a bent segment of railing. The whistling air pouring through rips in the hull. The eerie absence of sirens, since all alarm circuits had been fried by the EMP. The terrified shrieks, fading with the falling pressure. The bombardment by the bodies of the dead and dying. . . .

Eva walked beside him, a bit unsteadily; she had refused to leave *Harmony* until he did. The stars wobbled

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overhead, or so the starship's random tumbling made it seem. The world rumbled once more beneath his feet. "Hold on!" he shouted to Eva. Yet another section of the explosion-weakened hull ruptured, spewing gases and random flotsam into space. The magnetic soles of their pressure-suit boots were set to maximum, but as the ground shook, he clasped Eva's arm in a vise-like grip. *I won't lose you again.*

Deep pits and long, shiny gouges scarred the platform. He shivered every time they encountered a gash, for each was a crash site. UP warships crumpling into or careening off the starship's bucking deck had added hundreds more to the death toll. The pursuit ships were all EMP-protected, but they had run out of everything except weapons. They had a velocity into deep space of two percent light speed; their only possible source of deuterium/tritium and reaction mass for a return flight was the starship.

They marched toward the one ship remaining on the platform. The rest of the evacuation fleet had already launched. Fifty-three overcrowded vessels, some Hunter, some refueled human ships, had begun their long journey back to the warmth and light of Sol. No Centaur lifeboats joined them; like the starship itself, the lifeboats were unhardened against EMPs. Fortunately for the Centaurs, their spacesuits were entirely powered down when the disaster struck, and so were unaffected by the EMP.

So many deaths, and yet dangers still lurked. Arblen Ems refugees had once fled into exile in a cometary belt—and from there staged raids on their enemies. Might they do the same in Sol system? The risk was unacceptable: UP warcraft on the flanks and rear of the flotilla would destroy any ship that wandered from its assigned course.

At last they reached the waiting UP cruiser. Art and Eva shuffled up the ramp and into the inviting airlock of *Actium*. A peculiar keening startled Art as the inner door cycled open. He looked wildly about for its source, only to encounter the eagle-tattooed and smiling face of Capt. Aaron O'Malley. An honor guard standing stiffly at attention lined both sides of the corridor.

The bosun's whistle cut off abruptly. O'Malley gave a smart salute. "Welcome aboard, Ambassador. Doctor Gutierrez."

Art popped off his helmet. "You can't believe how good it feels to be back."

Actium launched moments after O'Malley, Art, and Eva entered the bridge. They watched in silence as what remained of the abandoned starship, still tumbling about three axes, still jetting gases randomly as more and more of the traumatized hull gave way, receded into the distance. Its farms and parks were dying or dead, its emergency fuel cells were exhausted, its stockpiles drained. The shattered, hemorrhaging wreck seemed neither victorious nor harmonious, only sad. You were a fine ship, Art thought. You deserved better.

He found Eva an empty seat on the bridge, then claimed another for himself. His eyelids drooped. The purposeful sounds of bridge operations washed soothingly over him.

Someone cleared his throat loudly. Art forced his eyes open.

"I *said*, Art," O'Malley said, "that there's a cabin waiting for you. Your work is done. Go get some sleep. We're pretty full this trip, though, so everyone is doubling up."

Art turned toward Eva and found her already looking at him. They shared a nuanced glance which said everything that needed to be said. "That won't be a problem," Art replied.

"Now, let's go home."

EPILOGUE

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CHAPTER 45

Ariel Colony: the United Planets protectorate inhabited by the Snake residents of Sol system (see related entries, *Harmony/Victorious* Hijacking and Himalia Incident).

No matter how aggressive or territorial a civilization, to be self-sustaining most of its members must make something other than war. In historic times, no more than ten percent of any K'vithian clan were ever warriors; fewer than five percent of the clan Arblen Ems survivors of the Himalia Incident were. Few combatants bore any responsibility for setting clan policy toward humans or Centaurs.

Most K'vithian evacuees were, by human standards, civilians: children, workers and administrators, infirm, and elderly. Although some evacuees might justly have been treated as prisoners of war, all were homeless exiles. Many became refugees long before *Harmony* first approached Barnard's Star.

Thus, in the aftermath of the Himalia Incident, the UP victors confronted a diaspora more than a defeated army. Any policy other than genocide had to address that unexpected reality, and hope in time to inculcate among the K'vithian exiles respect for the rules, and ideally the values, of the United Planets.

As a first step toward the UP goal of integration, clan Arblen Ems was settled for orientation and rehabilitation on a middling moon of Uranus: Ariel.

—Internetopedia

Arblen Ems Firh Glithwah, Foremost, as she always did upon entering her office, took a moment to study the desolate topography outside the well-insulated windows. Her view to one side was into an ancient crater, and to the other side, into a deep ravine. The gorge was but one minor example of the many interconnected valleys extending for hundreds of kilometers across the surface. On this face of the tidally locked moon, Uranus dominated the sky.

Ariel was half rock, half water and methane ices. Some of the scattered craters, including the one upon whose rim this settlement perched, had been made by large metallic meteors. Deuterium/tritium scooped from the beautiful blue planet that hung tantalizingly overhead satisfied all their energy needs. And therein, despite the abundance of resources, lay the problem—the clan was permitted no ships. That prohibition was what made the "protectorate" a prison.

The human norm for an office demanded a desk, and so her office had one. She did all her work and kept all records in cyberspace, securely encrypted. Everything on the desk, like the desk itself, was mere decoration. Be truthful, she told herself. Some items were sentimental, like the hand-carved wooden chess set. It was one of the few items salvaged from the Foremost's cabin before *Victorious* had been abandoned.

What would Uncle have said of their situation—besides that chess was simplistic and limiting? She missed his guidance, never more so than when unwanted guests arrived. Yes, she had become, as had her uncle and great-grandfather before her, the Foremost—but however confidently she presented herself, she took her responsibility as proof mostly of the clan's heavy casualties. Did anyone ever feel ready?

In minutes, ready or not, she had visitors.

With no more exertion than the occasional flexing of a boot sole or the feather-light press of fingers against a wall, the man known to everyone on Ariel as Carl Rowland propelled himself through the unusually crowded main corridor of Customs/Security. That effortless grace was the product of extensive practice; he had lived here

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for many years. None of the gawkers paid him any attention, which was fine with Carl. All eyes were on the woman he escorted, whom he had greeted at the Customs lounge with a bear hug.

Ten years after the linked destructions of Himalia and *Harmony*, Corinne Elman remained among the most recognized beings in the solar system. Her 3-V docudrama about battle aboard and escape from the starship was a bestseller in *two* solar systems—and probably in others from which sales figures had yet to arrive. Had she not assigned ninety-nine percent of her royalties to victims' families and survivors of Himalia, she would also have been not just wealthy, but fabulously, stinking rich. The only thought passersby gave to him was surely: How does *he* know *her?* They would never know the answer: as Helmut Schiller. That name, and the face that went with it, were buried. Who better than the UPIA to convince the world the Frying Dutchman in all his reincarnations had finally died? Who better to give him a new identity?

On the home/prison world of Arblen Ems, even the rich and famous, even friends of the normally dour deputy of the UP's viceroy, underwent the full security protocol. Corinne and her luggage were X-rayed, chemically and biologically scanned, and hand-searched. She took it in good spirits. "It's great to see you."

And how unbelievably good it was to see her. They arranged to cross paths every year or so, but never before on Ariel. "Welcome to my world, shipmate. When we're done here, I'm buying you the finest breakfast on the planet and giving you the grand tour." Neither commitment was as generous as it might have sounded, especially the breakfast part. Ariel offered two human-safe restaurants and a staff mess hall. "Then we can tend to your interview."

He should have known better. Soon after their meal, they were in the terrestrial-conditioned side of the Foremost's spartan but spacious office. Carl understood clan-speak, of course, but only someone with two independent sets of vocal chords could speak it fluently. Firh Glithwah as a matter of principle conducted business only in clan-speak. Pashwah-qith would handle the translations.

"Thank you for seeing me, Foremost."

"You are welcome, Ms. Elman."

"Corinne. I congratulate you on your recent ascension to this position." They traded courtesies a few times; long, by Snake usage. "You know why I asked to see you."

"To share your wealth with those who made it possible?" Pashwah-qith's closed captioning added, "Sarcasm," faster than Carl could net, "She's joking."

"Because your uncle was Foremost when the hostilities occurred. Because you can now combine what you might have heard as his closest surviving relative with records possibly only available to someone in your new position."

"I see." Glithwah did the ironic-laughter head circle. "All will now be revealed."

Somehow Carl doubted that it would.

Glithwah had been Foremost for months. Corinne's answer notwithstanding, the obvious reason for this interview was an upcoming "event": ten human-standard years since the destruction of *Victorious*. Humans fixated on anniversaries, which provided this human yet more opportunities to profit from the clan's misfortune.

Whatever the impetus, human curiosity was always a danger—the mental leap was too short from analyzing old motives to speculating about new ones. Glithwah strove always to keep the clan's captors fixed upon rehabili-

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tation, on reinforcing their wishful thinking that acculturation was progressing. It mattered not that she preferred to avoid questions altogether; declining interview requests could itself raise suspicions.

This reporter had good cause from personal experience to be skeptical. She also had a huge human audience, and apparently the ear of UP security. It all made her dangerous. Could Glithwah mislead as adeptly as had Uncle? "Your questions, Corinne?"

"When Mashkith surrendered, he did so to K'Choi Gwu ka. Why was that?"

Because we had just killed thousands of humans. And because the Unity, unlike the UP, never had a death penalty. Surely this was obvious? "A sudden decision at a very desperate time. Reasons lost with Foremost." Glithwah allowed the repositioning of an excavation rig deep within the crater to distract her for a time. "Absence of data. Very regrettable."

"Was surrender to the ka in recognition that the ship was Centaur? Might Mashkith have been making deathbed amends?"

"Perhaps, Corinne." Certainly not.

"Let me preface my next question with an observation." Corinne interlaced her fingers. "Imagine the lifeboat hijacking had gone undetected. The lifeboat rendezvoused with *Victorious*. *Victorious* set off to Barnard's Star, fully fueled. My question is: then what?"

"A very broad question." And a perilously perceptive one.

"Not really. Put another way: Could Arblen Ems possibly have prevailed once it arrived home? News of *Victorious*' appearance in Sol system returned home at light speed. Your own return would have been at, what, a third that? Long before Pashwah was quarantined, she must have sent word of your arrival in Sol system to the Great Clans. The UP's trade agent on K'vith would have, too. The other clans had ample time to prepare for your eventual reappearance."

Hunters do not fidget—especially not a Foremost. When Glithwah picked up the black queen from the chess set, it was quite intentional. It was a subliminal suggestion to her visitors: Think chess. Trust in predefined constraints. Believe in the polite and predictable taking of turns. Think inside the box. "Plentiful antimatter in our control. Opposition to clan Arblen Ems too dangerous."

"He may have intended divide-and-conquer tactics," Rowland said. "Ally with one or a few powerful clans more interested in their own welfare than in solidarity with the other clans."

Her thumb stroked away. Think chess. Think boundaries. Uncle had devoted years to strategy; did they think to penetrate his subtlety in minutes? Why should she instruct them? "Without insight for you. My apologies." Get bored with this session, please.

Besides, it was a novice's analysis. The risk of betrayal would have been apparent to the Great Clans for as long as they awaited *Victorious*. Exchanging hostages and co-locating key assets were time-tested countermeasures. There were many such possible dependencies to discourage treachery from within their coalition. Did the humans think Mashkith so desperate or imprudent to bet everything on hopes of undermining an alliance?

Conjectures flew. When Glithwah could, she left the humans to rebut and confound each other. Her most common reply, when pushed to speculate, was the pleading of ignorance. In this manner, they discussed without resolution: Would antimatter weapons used freely destroy the value of the conquest? Could antimatter weapons used sparingly overcome vastly superior numbers on the other side? Might the opposition clans' leadership exhibit Lothwer's death-before-dishonor fanaticism? How in each case might

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Mashkith have responded?

The question about Lothwer cut deeply. She pleaded ignorance once more, this time honestly so—she had been merely a deprived child of exile when the flight to Sol began. Let them believe Lothwer's weaknesses were more typical than Mashkith's devious brilliance. Glithwah's sincerest and never expressed worry was whether she had inherited the Firh family talents—or the family flaw of overreaching.

Rowland refused to drop the topic. "I don't see Mashkith embarking upon a strategy that involved a bloodbath. It doesn't fit what we know of him."

That was insightful—and hence, bad. It would not do for the UP security officer to understand. "Omelets versus eggs. Human metaphor."

He shook his head. "Mashkith was scary smart, but not a mass murderer. He might have threatened to attack major human settlements, even Earth itself, with antimatter—especially after he was the one holding all of it: He didn't."

"He didn't hesitate to destroy Himalia without warning." Corinne's hands trembled a bit, still enraged after so many years. "In the end, how many thousands died from that decision?"

Himalia had been a top secret, officially undisclosed, military research facility. It was a legitimate target. For the families who had lived there, and all those lost in the aftermath, Glithwah was sorry as Mashkith had been—but the humans themselves provided an appropriate term: collateral damage. As for warnings, even among humans, declarations of war were a quaint and often discretionary concept.

She articulated neither justification, for human misunderstanding suited her purpose. Forgive me, Uncle. "Himalia: evidence of Mashkith's single-mindedness. Implication: his readiness for application of antimatter until total victory on K'vith."

As inaccurate and unfair to Mashkith's memory as that impression was, Glithwah was relieved when her visitors departed espousing it.

CHAPTER 46

Twenty years lost in suspended animation, twenty years stolen as prisoners of the Snakes, thirteen years gone to the construction of a new starship and the new antimatter factory to produce its fuel . . . Eva sympathized with the Centaurs who chose not to spend many more years to return to the Double Suns. She had worked alongside enough Centaurs to know what a wrenching decision it must have been for a crew-kindred to sunder. Those electing to stay were made welcome anywhere they chose in the solar system. They had chosen to settle here.

The Australian Outback was breathtaking.

Achingly beautiful vistas beckoned wherever one went: vast stretches of desert sand and red sandstone, rock pools and wetland wilderness, towering rock formations and great canyons. Here one encountered boab trees with their immense trunks; there, groves of old-growth mallee, each dense thicket but a single ancient tree; yet elsewhere, great stands of eucalyptus and river red-gum trees. Everywhere there were fabulous animals: crocodiles and emus, koalas and wallabies, kangaroos and wombats and platypuses. And at night, one of the brightest sparks in a crystalline sky ablaze with lights was Alpha Centauri. It was all wonderful and eerie. In its ecological wholeness, it was more novel to Eva than to the Centaur friends who took delight in showing it to her.

She hoped to find their home world as fascinating.

"Are you sure you want to do this?" Allyson Walsh was taller than her father. Her hair and complexion were as dark as Art's were Nordic. Spend ten

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minutes with her, though, and Art's influence was palpable, even without knowing the young woman was an engineer. Eva and Allyson were strolling in the deepening dusk along the great salt flat that was Lake Torrens.

"This," was a broad concept. Being a part of the first human expedition to another star. Observing firsthand the operation of the first human-built starship. Guiding the program of physical measurements and interstellar observations along the way. Collaborating at their destination with the Unity's leading physicists—those whose insights had made the ship possible, whose quantum-gravity theory she was only now beginning, she flattered herself, to fully grasp. Cultivating the still delicate relationship with humanity's nearest neighbors. Accompanying home good friends. "This" was all those things.

Twenty meters ahead, Art walked side by side with his son Bart. It was an evening for goodbyes, which was the true significance of Allyson's question. "This" also meant thirty years absence from everything Eva knew, and from almost everyone she knew, including her stepson and -daughter who had come down from the moon to see them off. "Am I sure? Hell, no. But what an adventure it will be."

"And of course there is no stopping Dad. I'm glad you'll be together." Allyson cocked her head. "Although how Dr. Claustrophobe plans to handle fourteen years each way cooped inside a flying pebble is a mystery to me."

"Believe me, I've asked him that. After the tenth try, I got a credible answer. Art said, 'Life within a fraction of a cubic kilometer of rock *will* get to me. When it does, remind me that just outside are trillions of klicks of emptiness in every direction. Remind me we've all been forced until now to spend our lives trapped in one little solar system.

" 'A galaxy should be roomy enough even for me.' "

Hard ceiling rails and padded bucket seats; potted ornamental dwarf bluefruit vines and no-nonsense holo status displays; photonic and biocomp components commingled beneath the sculpted plasteel panels of control consoles . . . here on the bridge, the collaborative nature of *New Beginnings* was unmistakable. The ship soon to take them home was a joint effort with the United Planets. Not for the first time, Gwu thought how auspiciously named was the human polity—and how different everything would have been if Sol had been *Harmony*'s chosen destination.

"I never thought we'd get here." Art Walsh floated nearby, at more or less right angles to Gwu, a big smile on his face. "It's been a long time coming."

Not nearly as long as for the crew-kindred, many of whom bustled around her tending to last-moment details. Too long, in fact, for many. Gwu could openly admit to sadness at the coming separation; she shared only with Swee her touch of envy. How wonderful it would have been to stay and explore. But for all the temptation, her commitment to duty never wavered. She would bring home everyone who wished to return. "Great rewards merit great efforts."

"Fair enough. Be right back." Art shoved off to consult on yet another calibration check of the main comm console. All around her, small clusters, more often humans and crew-kindred together than groups of either species alone, murmured purposefully.

In a saner universe, the main holo would have celebrated nearby Saturn in all its ringed glory. Instead, that display presented the many warships swarming around *New Beginnings* and Prometheus, the little moon on which their antimatter had been produced.

Eva Walsh-Gutierrez and Swee

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emerged from the central-core elevator, back from inspecting the engine room. Swee swung gracefully from rail to rail to rail, stopping at Gwu's side. "We can fine-tune forever. My opinion is we leave now and putter later." He entwined a tentacle in one of hers. "What says the ka?"

"That she is eager to see the Double Suns again." She called out to all on the bridge, "Stations, everyone."

Gwu polled: power, propulsion, comm, navigation, trim and spin, ecosystems, logistics. Everyone was ready. Art and Eva settled into human chairs to one side of her. Swee took his place on her other side.

"We did it, you know," Swee said. "Nothing happened as we expected, and too many were taken from us—yet we did everything and more that we set out to accomplish. The technology is proven. We leave behind our first colony. We return home with new friends."

"The birth of an era," Art agreed. "We've been privileged to see the beginning of a true interstellar civilization, so much more than an interstellar comm network. A new order of things."

Gwu had one final check to make. "System integration, what is our overall status?"

T'bck Ra's synthesized voice was loud and clear. "Everything is operational and ready."

"I ask everyone to observe a moment of silence for those who fell along the way." As so many had, across so many light-years. Then, with a single joyous word, Gwu began their journey.

"Engage."

CHAPTER 47

Arblen Ems Firh Glithwah, Foremost, as she always did before leaving her office, took a moment to study the desolate topography outside the well-insulated windows. While she had labored, a bit more of the ancient crater had been disturbed in the never-ending quest for metallic ores. A little more of the moon's icy surface had been strip-mined for precious volatiles. Another new edifice had begun to emerge in the distance, much of its structure made of the fused tailings from continuous tunneling and mining. We are prospering here, she thought, and the humans do not understand the consequences of that prosperity. They lack the long view.

Times were hard when Glithwah was little. Her parents worked two of three shifts to survive, leaving her often in Great-Grandfather's charge. Few of those early memories were happy, but there were exceptions. One exception was Great-Grandfather patiently introducing her to b'tok. "The game of Foremosts," he often called it.

Had she finally attained Great-Grandpa's standard? She would never know. He had died with most of her family, in a far-off crash into what would become known as *Victorious*.

Fifteen standard years ago *Victorious* had been abandoned, making today yet again a day of interviews. She picked up the black queen, which stood forlornly on a corner of her desk. She restored the piece to its accustomed place of show, blink-blinking. Chess was all about constraints. Everything in chess was bounded by sixty-four squares, the prescribed capabilities of thirty-two predefined pieces, a time limit. Despite all the vitality of their civilization, all their expanding wealth, all the upheaval wrought by the arrival of *Victorious*, human thinking remained, if not static, almost always short-term.

Mashkith had never shared his long-term plans with her. Perhaps Uncle had disclosed them to no one. Anyone to whom he might have communicated them had surely outranked her—and was doubtless among the dead. But she knew her uncle—and she, like

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he, knew to plan for the long run.

Many questions had been posed to her today. As always, a few topics were uncomfortable. As always, the humans missed the crucial point. Perhaps the matter was obvious only to those who thought dynamically: What if, during the long absence of *Victorious*, an at-home clan obtained antimatter technology? It might have been independently developed, or stolen anew from a second herd starship, or purchased over InterstellarNet, or even transmitted freely and vengefully to K'vith by those thirsting for retribution against Arblen Ems.

That risk alone precluded a return home.

The clan dared not go—and dared not remain—anyplace where vastly superior numbers held, or might obtain, technological near-parity. As certain as Glithwah was about anything in this universe, their initial course towards K'vith was misdirection. Mashkith would have changed course soon after *Victorious* receded beyond human observation.

InterstellarNet was a yellow-sun club; K'rath was the single red-dwarf star home to a member species. Mashkith had surely planned to take them to another nearby red dwarf. She guessed the star known to the humans as Lacaille 9352, more distant from herd, human, and Hunter suns than all those stars from each other. And if not Lacaille 9352, other red dwarf suns had been within their cruising range.

Thereafter, even if their new colony were prematurely observed, who would invest the decades and treasure necessary to pursue them?

Exploiting the uncontested resources of an entire solar system, the secrets of antimatter and the interstellar drive, and time, there was no limit to what the reborn Arblen Ems might have accomplished. Perhaps, in a few generations, even a triumphant return to K'vith. . . .

A scoopship passed overhead, delivering essential energy supplies. A human scoopship. Only in her thoughts did Glithwah bare her teeth and growl. She could be under observation at all times. She acted accordingly.

Someday, the well-behaved, increasingly prosperous survivors of the Himalia Incident—or if need be, their descendants—would have the humans' trust. Someday, the spaceships that frequented Ariel would be controlled and flown by Hunters. Someday, the clan would freely roam this solar system. And someday, another starship would come within their grasp.

Arblen Ems was twice before a Great Clan. It will be a Great Clan again. ■

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THE REFERENCE LIBRARY Tom Easton

The Clan Corporate, Charles Stross, Tor, $24.95, 320 pp. (ISBN: 0-765-30930-0).

The Baby Merchant, Kit Reed, Tor, $24.95, 334 pp. (ISBN: 0-765-31550-5).

Skybreaker, Kenneth Oppel, Eos, $16.99, 369 pp. (ISBN: 0-06-053227-0).

Crystal Rain, Tobias Buckell, Tor, 352 pp. (ISBN: 0-765-31227-1).

Gift from the Stars, James Gunn, BenBella Books, $14.95, 154 pp. (ISBN: 1-932100-65-2).

One Million A.D., Gardner Dozois, ed., Science Fiction Book Club, $13.99, 399 pp. (ISBN: 0-7394-6273-3).

Trilobite Dreams or, The Autodidact's Tale, A Romance of Autobiography, Robert Reginald, Ariadne, $14.95, 128 pp. (ISBN: 1-57241-133-3).

Intelligent Thought: Science versus the Intelligent Design Movement, John Brockman, ed., Vintage, $14, 256 pp. (ISBN: 0-307-27722-4).

Kiddography: The Art and Life of Tom Kidd, Tom Kidd, Paper Tiger, $29.95, 128 pp. (ISBN: 1-84340-201-7).

Charles Stross's Family Trade series continues strong with **The Clan Corporate**, but though ace investigative reporter Miriam Beckwith, now revealed as heiress to a world-walking transdimensional Mafia clan, continues to leap from frying pan to broiler to fire, the tale is no longer quite what it was.

What was it? The world-walker Clan has grown wealthy and powerful by carrying high-value, small-volume goods such as drugs around borders by ducking in and out of their parallel world. Miriam is a woman of modern Western culture. She is tough-minded, independent, and competent, and when she sees an opportunity to revamp an economically unstable enterprise (drug-running collapses if anyone wises up enough to put drugs on a legal prescription basis) by importing modern inventions (such as brake pads) into a primitive world, she grabs it. But the Clan is highly hierarchical, part of a very traditional culture where women just aren't independent beings. She must be brought to heel, married off, and set to making Clan babies. She ran head on into the situation in Book 2, *The Hidden Family* (reviewed here last January-February), but until near the end of that book she seemed to have things well in hand. But then treachery was revealed. Matthias, a highly placed aide who had been conniving with an estranged branch of the Clan, vanished.

She doesn't have anything in hand at all, now. The political situation is messy, people tell Miriam. That's why you're being kept close to home. But the situation is a lot messier than the Clan thinks. Matthias vanished to our world, where he promptly started talking to cops, who as promptly started raiding Clan depots and catching drug-runners. What's this? screeched Homeland Security, FBI, CIA, NSA, et al. World-walkers? Who can pop out of nothing anywhere they like? Even inside the White House? And

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now the feds are looking for ways to invade the Clan's world and put a stop to a major national security threat. They're not playing nice about it, either. While the research boffins are working on a techy way to hop the worldlines, the troops are making do, forcing captured Clan members to carry soldiers across on their backs. Infiltration is under way.

Meanwhile, the marital machinations have progressed to where Miriam is about to be betrothed to the King's brain-damaged younger son. The morals-damaged elder son is cooking up a coup. And it all comes to a head in *Clan Corporate*'s crash-bang finale.

But as I said, every time Pauline—oops, Miriam, though she seems to face as many perils as ever did the famed melodrama heroine—jumps out of a hot pan she lands in another hot spot. The pattern holds, and the next volume has to be a "Now what?" installment. If I may be allowed to guess, Miriam has had a run-in or two with the local representative of the estranged branch of the Clan, one James Lee. She has even flirted with him, so—unless Stross is being just *too* subtle—there is now a great excuse for him to come to her rescue.

Watch for it.

In the future America of Kit Reed's **The Baby Merchant**, it is difficult to be a mother. Fertility has fallen, and the supply of babies waiting to be adopted is much reduced. In fact, there are baby mills (much like puppy mills!) and even clone farms. What's more, the U.S. government has passed laws requiring that babies be implanted with ID chips without which access to higher education, airports, and decent jobs is denied.

The situation provides an obvious opportunity to Tom Starbird. Rejected if not neglected as a child, he has a strong drive to rescue other such kids. He therefore looks for "unwanted" babies—with "unwanted" defined as unchipped, neglected, yelled at, abused—kidnaps them, and delivers them to childless couples he thinks will make good parents. He vets his "product" (the kids), the "suppliers" (their parents), and his customers quite carefully. He is doing good, he tells himself, doing major favors for all concerned, and if he charges his customers major bucks, well, he has major expenses.

Now meet Sasha Egan, unwed mother, ready to give up the baby as soon as it's born, at least until the cad who knocked her up tracks her down and demands his parental rights. Why, he'll even marry her, and they can live off her rich grandmother for the rest of their days! But Sasha doesn't want anything to do with either him or "Grand." She runs.

Meet a Boston couple, Jake Zorn the muckraking journalist and his wife Maury. They want a kid *bad*, but though they have plenty of money, they're a bit old for the adoption agencies and Maury has spent a bit of time in the rubber ward. They're desperate, and then Jake finds out about Tom, digs into his past, and threatens him with exposure of his rejecting mother unless he comes through.

Tom's pretty sure this customer is not a good choice, but what's he to do. He should just cut and run. There's plenty of money in his Swiss bank accounts. He has the plane tickets. But what about Mom? Sure, she was rejecting, but parenting is a major life-stress, and besides, she's Mom!

Speaking of stress, there's plenty to go around. Sasha is hurting, but please don't anyone dare get between her and her baby! Maury Zorn had a breakdown. So did Tom's Mom. Now Tom has to come face-to-face with the pain he causes and the conflict between that and the delusion that he's been doing good all these years. Can he make it all right? How?

Reed has taken the angst that we can see surrounding parenting in today's world, exaggerated it with the aid of market demand, and produced a starkly

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obsessive denouncement of all those who would exploit mothers, children, and the desire for children. She is an extraordinarily skillful writer, and *The Baby Merchant* is very much worth your attention and the awards it is bound to win. But be warned, it's not an easy read. It may even make you wish for a dose of Prozac.

Kenneth Oppel's **Skybreaker** (sequel to *Airborn*) is a young-adult novel that quite nicely echoes the tone of Jules Verne. The basic idea is that the age of zeppelins never died, the airplane never got off the ground, and 15-year-old Matt Cruse can make himself a hero by fighting off air pirates and then, despite poverty and lack of schooling, enroll in the Airship Academy of Paris. *Skybreaker* opens with Matt on a training cruise aboard a decrepit airship, the *Flotsam*, trying to get around the Devil's Fist, the near-permanent typhoon over the Indian Ocean, when they spot an ancient derelict far above them. It's the *Hyperion*, famed for the wealth it carried, and when the captain plunges madly toward its 20,000-foot altitude, the crew quickly succumbs to anoxia. Matt barely makes it home alive, bearing with him the memory of the *Hyperion*'s coordinates.

Folks are interested in those coordinates. Kate, his feisty, wealthy, young companion in the previous adventure (whom he moons after like any lovestruck teen) wants to go salvage the treasure and knows of a "skybreaker" ship that can function at extreme altitude. But she's not alone. Matt is lured to a hotel room by desperadoes who try to talk him out of the coordinates. When he refuses and flees, they pursue him across the rooftops of Paris until the fair young gypsy lass, Nadira, helps him escape. She, of course, has the key any salvagers will need to salvage anything at all, and soon Matt, Kate, Nadira, and Hal Slater, the suave captain of the *Sagarmatha* in whom Kate seems far too interested (while Nadira seems rather interested in Matt), are off. Alas, there are monsters in the sky—squidlike creatures with electrocuting tentacles (this is Earth?). But they prevail and reach the *Hyperion*. Unfortunately, the desperadoes are hot on their heels and an insanely dramatic finale is essential to bring all safely home again.

If you have a teen who's been enjoying Verne and might like a bit more retro tech, unlikely zoology, and thorough melodrama, get this one. If the teen's a budding feminist, it might not go over quite so well, for the major hero is the boy and the girls do tend to get sidelined at crucial moments. But then, that's part of the classic mode, isn't it?

Tobias Buckell grew up in Grenada, the US, and the British Virgin Islands. He lives in Ohio now, but his background has given him a sense of the Caribbean ambience that is serving him well as he begins a promising career as a novelist. His first novel, **Crystal Rain**, is the sort of thing that will have readers watching for more.

The back-story is perhaps as crucial to the novel as the tale itself. According to Buckell, when Earth reached for the stars, it found folks already there. The ensuing debacle sent human refugees hunting desperately for worlds without aliens. One group—a mixed bag of Caribbeans, Aztec wannabes, French-speakers, and others—succeeded. But hot on their heels came the Teotl. The ensuing war destroyed the wormhole through which all arrived, as well as technological civilization, and in the centuries since the Teotl have cultivated Azteca bloodlust and prowess. Now they're coming across the mountains to the land of Nanagada to capture, enslave, and sacrifice all the rest of the planet's human population. And the wormhole, once damaged to prevent the onslaught of Teotl hordes, appears to be healing. Soon, in a century or so, it will be a doorway to horror once more.

There seems little hope. But a myste-

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rious fellow named Pepper has appeared. He has superhuman abilities, and he is looking for an old friend who never misses carnival. Meanwhile John deBrun, who washed up on shore years before with no memories of his past, is preparing to go to carnival with his wife and son. One of the dread Teotl is ordering an abject spy, Oaxyctl, to hunt down deBrun and get from him the codes to the Ma Wi Jung, apparently a superweapon left from the old days.

After his wife and son are off to town for carnival, John lingers at home to pack. He knows the Azteca are coming and they must leave. But before he can do so, they arrive. He is a prisoner, and the priest is waving a bloody knife in the air. Fortunately, Oaxyctl shows up.

Meanwhile, at Capitol City, folks are desperately trying to prepare defenses. They are helpless before the hordes coming their way, plagued by traitors within the city's walls, and sure that they cannot spare the resources to hunt for the Ma Wi Jung they have discovered lies hidden in the icy waste that now covers what was once known as Starport. But here come John and Oaxyctl, the latter awaiting his chance to torture and interrogate. Here comes Pepper, knowing what John has forgotten. Here come the Azteca hordes. And finally Capitol City must face the fact that the desperate chance is their only chance. John and Oaxyctl—and only the reader knows what other traitors—and Pepper are on their way.

Starport? The reader may well suspect that the Ma Wi Jung is a spaceship. If it is armed, it could well be just the superweapon needed to defeat the Azteca and the Teotl. Even if it is not armed, though, it should be quite useful, for its drives could vaporize airships, its weight could crush armies, and perhaps it could even ferry refugees out of harm's way. But the exact nature and powers of the Ma Wi Jung are not revealed till late in the tale. As for the codes that John supposedly knows, he has lost his memory, remember? How can he give up those codes, or use them? And never mind that he is progressively more damaged, wounded, gangrenous, delirious, and near death.

The reader patiently awaits the inevitable climax when all is revealed and the chestnuts emerge from the fire. Buckell does not, however, make the mistake of saying everyone will live happily ever after. The Azteca are defeated (for now), and that wormhole is healing. A nasty future awaits. But the people of Nanagada must deal with that when it comes.

Will there be a sequel? The package gives no hints, but there's room, and the back-story has the potential for prequels. Buckell has displayed a gift for imagination much greater than one book can hold. Sequels would surely please many readers, but if he imagines as thoroughly in new and unconnected novels, they too will please.

Over the last few years, James Gunn published a string of novelettes in this magazine. The basic idea (see "The Giftie," September 1999) was that a rocket scientist found in a remainder bin a UFO-nut book that had in its back pages diagrams that seemed to describe a genuine, workable starship. After suitable investigation and negotiations, the starship became real and the intrepid crew was off to visit the aliens who had sent the designs. The tale is now in book form as **Gift from the Stars**, with the last two sections, "Uncreated Night" and "Strange Shadows," somewhat different from what appeared in the January/February 2005 *Analog*.

The tale is not complex. Much of the progression from finding the book to building the starship is omitted, and the progression thus seems far too easy. The aliens remain offstage, and the resolution owes far too much to the deus that pops up in the machine. But the ideas are interesting, and if you remember the individual stories fondly, you surely

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want the book.

Enjoy!

The Science Fiction Book Club keeps sending me books that aren't quite the traditional book club sort of thing. They are priced affordably, but they're not special editions of books from other publishers. They're SFBC originals, and that makes them fair game for this column.

The latest is **One Million A.D.**, edited by Gardner Dozois. The gimmick is stories set much, much further into the future than usual. For the occasion, Robert Silverberg ("A Piece of the Great World") revisits the world of *At Winter's End*, when the rain of comets is finally over and folks can finally emerge from the burrows; folks are not human, however, for genetic engineering and evolution have long since, and more than once, replaced our kind. Robert Reed in "Good Mountain" visits a colony world where civilization has grown upon a mass of floating vegetation, which periodically disintegrates. Nancy Kress's "Mirror Image" gives us a galactic civilization centered on QUENTIAM, an omniscient supercomputer that resides in the brane of reality; normally it enables people to slip in and out of bodies and perform quite extraordinary tasks, but something is going wrong, worlds are dying, and all-knowing QUENTIAM isn't even aware of the problems. Alastair Reynolds' "Thousandth Night" involves a clone clan that roams the galaxy collecting experiences and periodically meets to share memories; at this reunion, there is a murder mystery. Charles Stross's "Missile Gap" peels Earth like a grape and spreads it across an infinitesimal fraction of an accretion disk with a great view of a Milky Way that looks like it has been engineered. The new world has wide oceans and numerous continents, on one of which explorers find ruins of Earth's cities, quite as if the peeling is a repeated event; if you choose to call it a murder mystery, don't expect a happy ending. Greg Egan's "Riding the Crocodile" considers just how an immortal couple might go about deciding to call it quits, and how long they would take to do it.

A stellar lineup and excellent stories whose greatest defect is surely that they are so understandable to our present-day minds. Their characters are familiar in thought and pattern, despite the obvious departures, motives are familiar, and the story situations are not beyond our grasp. With my tongue slightly in cheek, I cavil that so far in the future there should be more—and more fundamental—differences.

Robert Reginald (pen name of Michael Burgess, professor and librarian) is well known in the SF&F field for his scholarly endeavors, for running Borgo Press for many years, and most recently for such interesting novels as *The Exiled Prince*. Most folks, however, are unaware that in the summer of 2003, he suffered a near-fatal heart attack. During the recovery period he eased up on his workload and began concentrating on what he loves best, his writing. That has included a number of reflective, autobiographical essays that reveal a thoroughly likable Type A fellow, review his life from childhood on, and comment at some length on just what surviving a heart attack does to you. Since many of us may face a similar crisis at some point (my own father wasn't much older than I am now when his heart gave out), **Trilobite Dreams or, The Autodidact's Tale, A Romance of Autobiography** has a certain relevance quite aside from the author's eloquence, which is more than enough to make the book very readable.

If you have any interest in the people behind your favorite literature, you have a shelf full of biographies and autobiographies. (I do!) Add this one to the collection.

The US is remarkable for the life that remains in the religion-based delusions

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that the world (the universe, even!) is only 6,000 years old and that evolution is "just a theory." In all the developed world, only here could we have school districts seriously trying to put creationism (currently known as Intelligent Design, or ID) into the curriculum or to remove evolution from tests (so that teachers who teach to the tests will skip over it). Even geology and astronomy, insofar as they deny that 6,000 years, are under attack.

Fortunately we also have judges who can laugh the creationists out of court, referring to their arguments as "breathtaking inanity." Unfortunately, that is not enough to shut the other side down. Their agenda—mooted amongst themselves if not in open court—is to revive theistic supernaturalism; their strategy is to defeat materialism by cutting it off at its source, in science.

If I sound a bit extreme, too bad. I'm a scientist and a materialist, and I was very happy to find **Intelligent Thought: Science versus the Intelligent Design Movement** in my mailbox. Editor John Brockman invited sixteen scientists and other scholars (including Leonard Susskind, Daniel Dennett, Tim White, Richard Dawkins, Steven Pinker, Lee Smolin, Stuart A. Kauffman, and more) to contribute to "a thoughtful response to the bizarre claims made by the ID movement's advocates, whose only interest in science appears to be to replace it with beliefs consistent with those of the Middle Ages." The resulting essays explicate evolution, dissect the ID movement and its real intent, discuss consciousness, SETI, and complexity, and in general defend the bastion of science against the barbarian yahoos. I found them pungent, cogent, fascinating, and illuminating, and so may you.

Unfortunately the book is a perfect example of preaching to the choir. I find it hard to imagine that a creationist or IDist would read it.

If Tom Kidd's artwork has a recurring theme—other than considerable talent and wit—it is Laocoonian entanglements. Again and again, his paintings include statues and wall paintings showing heroes wrapped in snakes and dragon tails or maidens wrapped in snake-like veils. What this says about the artist's psyche I leave to those more qualified than I, for Kidd himself is silent on the matter, if not on many more. In **Kiddography: The Art and Life of Tom Kidd**, he deploys a pleasantly self-deprecating humor to display in both text and art his past, his id, his profound horrors, and more. As usual with such a book, the experienced reader is reminded of past pleasures. If those pleasures included a book's cover as well as its content, they are enhanced by revelations of the thinking and influences that went into the artwork.

A distinct pleasure and essential to anyone who pays attention to SFF art. ■

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BRASS TACKS

Dear Dr. Schmidt,

Your editorial in the April 2006 issue of *Analog* ends with the proposition that "killing others of your kind is bad, period." While I agree that this is probably close to correct, the novel *Courtship Rite* by Donald Kingsbury certainly presented a plausible situation that called this and other standard "do nots" into question. I don't offer this as an actual counterexample to your proposition, but rather as food for thought. (You may have left this out of your editorial because the book may be unfamiliar to many of your readers.)

I think it is clear that prescriptions that ignore human nature do not work (well). If we only knew just what "human nature" is and what variables are involved, we could make firm statements about human relationships. For example, it is possible that Kingsbury's situation would never occur because actual humans could not change in the ways posited. Until we actually *know*, we have SF to provide us with thought experiments to compare to historical examples and help us consider what may be firm and what may be variable.

Dean Hartley
Oak Ridge, TN

And those thought experiments and apparent exceptions are important to consider. However, please note that I did not say, ". . . and therefore should never be done." You forgot the rest of the quote: ". . . even if it sometimes becomes necessary in order to avoid greater badness." Courtship Rite *is certainly an especially interesting situation, and many of our readers do know it, because we serialized it here. But I suspect even the members of that culture who were necessarily killed were less than fully enthusiastic about it and would have welcomed an alternative. (Food for thought, indeed! I almost got myself thrown into a swimming pool for remarking that the matter was handled "tastefully"!)*

Dear Dr. Schmidt:

You've done it again! You've run the first part of an extended story as if it were a standalone story. I'm referring to "Boundary Condition" by Wil McCarthy in the April 2006 issue. The story ends with nothing whatsoever resolved; it fact it ends in a cliffhanger exactly as one expects an episode of a serial to end. The difference is that the next installment will not be in the next issue (I'm sure of that because the May issue has already come, and it's not in it). No telling how many months or years will pass before we get the next piece of the story, and then there won't be a synopsis to tell us what's gone before. I've written you about this practice before, but you still haven't changed your ways.

All that aside, however, I find myself against my will fascinated by the proposition that quantum decoherence can suppress free will. McCarthy doesn't give us a real idea of what it feels like to someone undergoing this effect. He seems to imply that the victim wouldn't

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notice anything unusual. My own idea is that free will is inseparably intertwined with consciousness, and therefore anyone robbed of all free will would simply be rendered unconscious. The only thing supporting this idea is that it works the other way around: after all, an unconscious person has no free will at all.

I'm anxiously awaiting "The Pope and the Weatherman."

I have some comments on "Lighthouse" by Michael Shara and Jack McDevitt as well: It seems the *recently discovered* chimeras mark the positions of *already known* black holes. What good is a beacon that is harder to detect than the danger that it is warning about?

The story uses a frequent SF idea: that of a space elevator suspended from a geosynchronous satellite. I've often wondered about that idea. What supports the weight of the cable (or "nanowire ribbon"), which is at too low an altitude to be in orbit? Possibly the satellite is at a higher orbit than a free-orbiting geosynchronous satellite, thereby experiencing a greater centrifugal force to balance the additional centripetal force from the cable. Does that sound right?

Another problem: Since a geosynchronous satellite has to orbit over the equator, doesn't the base station also have to be on the equator? According to my atlas, Mt. Kilimanjaro is about 2 degrees south of the equator. Wouldn't that cause a sideways drag on the satellite, thereby wrecking its orbit?

Bruce M. Foreman
Chambersburg, PA

Neither Mr. McCarthy nor I will rule out the possibility of a sequel—any sequence of events, whether in fiction or real life, will be followed by others, some of them related—but we don't agree that one is required. We're sorry you didn't find the ending satisfying, but that doesn't mean there wasn't one.

As for "Lighthouse," one of the authors replies . . .

Hi Mr. Foreman,

Good questions. At her thesis defense, Kristi states:

"I would argue they were deliberately placed in orbit around black holes that were born without companions.

Some of each chimera's stellar wind now falls towards its black hole. That gas is super-heated so X-rays are radiated. That's why the chimeras coincide with catalogued X-ray sources. They used to be invisible. Now you can't miss them."

The chimeras' wind makes the black holes "visible" in X-rays. Before the chimeras were placed in orbit around those black holes, they were invisible. The chimeras themselves aren't effective beacons; it is their superheated winds that do the trick. Because these black holes now radiate X-rays, as a result of an engineered nearby wind source, humans were able to discover them.

And there's no problem with Kilimanjaro. See http://www.mit.edu/people/gassend/publications/NonEquatorialUniformStressSpaceElevators.pdf, especially Figure 7. You need to supply a horizontal tension, and your efficiency is about 5% less, but you regain a lot of that by starting up high. And yes, you place the geosynchronous station a little higher to produce the tension to support the cable.

Mike Shara

Dear Dr. Schmidt,

In your May 2006 editorial, you mentioned that Seattle faced a potential threat from a volcano (presumably Mt. Rainier). You did not mention a more likely threat from a devastating earthquake. Seattle sits on top of a fault. Every few years we experience a class 5 earthquake that does not do much damage. According to the seismographs, we frequently get little shocks that we do not even feel. However, the geologists tell us

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that every so often in geologic time, the Seattle area gets a devastating earthquake (7 or more) with a tsunami, and that we are due for a repeat.

Why do we want to live here?

Answer: mild climate, beautiful scenery, no yearly hurricanes, tornados, floods, or blizzards.

Look at Japan—tsunamis, typhoons, earthquakes, and volcanic eruptions, but the Japanese still choose to live there.

Switzerland has avalanches. Kashmir has earthquakes. Sicily has Mt. Etna. North Africa has plagues of locusts.

Anywhere in the world has some sort of threat. We just accept it as the price of living there. If you do not like it, move somewhere else and accept the risk(s) of your new home.

Brian Cary
Seattle WA

You don't need to sell me on Seattle—that is, in many ways, my favorite part of the country! Naturally every place has risks and, as you say, you have to choose which ones are worth living with—but in the process, you also have to consider the likely costs.

Dear Stan,

Regarding your editorial in the May 2006 issue.

I agree offering Federal Flood Insurance without regard to risk evaluation was and is a large mistake—one which would not have been made by private industry which likes to make a profit. Without such insurance, who would lend anyone money to build on the coast or flood plains?

In my area, along the northern Mississippi river, there are people who get flooded out one year in three—and rebuild in the same place.

The current government answer is to attempt to get *everyone* to purchase flood insurance—so the taxpayers can pay for the idiots outside of their tax bills.

I disagree that expanding population necessarily means we must build and live in high risk areas—we can concentrate our population vertically in stable areas, using the others for agriculture, recreation, and nature preserves—where the number of people at risk is minimized. In tornado and hurricane areas with enough altitude to avoid storm surge, we can build hurricane resistant buildings. (See www.monolithic.com)

As to the long term safety of the planet, no place is risk free—don't put all your eggs in one basket. Part of the reason that major storms and other disasters kill so many fewer people in the technologically advanced countries is that they can draw on resources further away from the area.

There is argument about the risk of "large rocks" and extinction events, but they are *irrelevant*. Do we care *what* causes these events? Or is it insufficient to know that some sort of extinction level event happens every few million years? Sure, the really big ones get all the attention, but there are many, many more confirmed smaller events.

We do not need to protect our "eggs" better in the basket: we need more baskets, widely separated if the species is to survive. Whoever takes the risk to move off the planet will inherit the universe (or at least our section of the galaxy).

Charles M. Barnard
Menomonie, WI

Dear Mr. Schmidt:

Re: "Home, Vulnerable Home," *Analog*, May 2006

Editorials are concise and to the point, so there was little room in your editorial for the nuances associated with the repercussions resulting from the hurricane damage to New Orleans. Nevertheless, considering the lessons to be learned from New Orleans, I feel obligated to respond. In terms of New Orleans' location, the decision (in 1718) to establish the city at its location was *not* irrational and akin to the

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mistake of camping in a dry wash. New Orleans became a hazardous location as a result of nearly 300 years of inappropriate terraforming. To explain, channelizing the Mississippi river system deprived the area of sediment. This, in conjunction with urban growth, allowed the city to subside to below sea level and eliminated protective wetlands. To theoretically "solve" the threat, pumps and levees were used to protect the city. Unfortunately the engineering and political commitment to maintain these facilities was lacking. The result, as we all know, was a cumulative and sudden catastrophic failure.

I totally agree with you that we are losing our sense of personal responsibility. As I watched the story unfold, I was taken aback by the growing cacophony that the federal government was slow to respond and failed to protect its citizens. I am not attempting to defend FEMA, as disasters can overwhelm any government's ability to respond. To paraphrase an old saying, "no battle plan survives contact with the enemy." One of the first things I have been taught relative to natural disasters is to be personally prepared to live on your own for three to seven days. It seems that those seeking to point the finger of blame towards the federal government have overlooked this level of personal preparedness and responsibility. Furthermore, both the city and state governments (as responders who should have interceded before the federal intervention) were themselves not up to the task. In our hierarchical system of disaster response, the federal government is theoretically the agency of last resort. Unfortunately, the so-called pundits have designated the federal government's response as the scapegoat. That will translate into the federal government becoming the lead agency for future disaster response and reconstruction rather than the agency of last resort. Personal responsibility is being placed into the hands of Big Brother.

Stephen Rynas
Morehead City, NC

Dear Dr. Schmidt,

I am writing to complain both about Harry Turtledove's Sherlock Holmes takeoff in your May edition, "The Scarlet Band," as well as what I feel was a poor editorial decision on your part to print it. Without commenting on the quality of the idea, the writing, or any apologia to Sir Arthur Conan Doyle, Dr. Walton's overt bigotry served no literary purpose in this story and was extremely offensive.

As a Holmes buff, I know Watson was often prejudiced, particularly as a literary device to set up and elevate Holmes' compassion and knowledge, or to show (and hopefully correct) the ignorance and contempt of the typical Englishmen towards the WOGs (and that's work order guys, never directly a racial epithet) that arose from the manifest destiny idea of the British Empire on which the sun never set. However, Watson was never vulgar or racially prejudiced, as Turtledove's Dr. Walton certainly is.

I was personally affronted and insulted, and surprised that you would publish such a story where derogatory language (consistent with the historical period, but still, if not therefore more so, upsetting) served in no way to further the story line, to set up conflict to be resolved, or to teach some moral lesson to the reader (or to Dr. Walton). In fact, despite the one sentence comment (yours or Turtledove's) before the story begins, and despite Walton's diatribe at the end of the press conference as to Helms seeing facts unclouded by beliefs, thin platitude by a character revealed to be duplicitous and opportunistic is much too little, much too late. There are much better ways to have painted Walton as the ignorant, bigoted buffoon. The author far overstepped the bounds of artistic license for no true need.

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I hope that you will continue to publish your usual, high quality fiction in the future.

Douglas A. Smith, Ph.D.
Camp Hill, PA

The author replies . . .

I fear Dr. Smith is satire-challenged, which is almost sure to be incurable. If poking some fun at the classics affronts and insults him, I suggest that he needs to find a more wholesome vent for his spleen. Yes, I'm guilty of making explicit what's implicit in much writing from the comfortably secure and even more comfortably superior world of nineteenth-century Britain. If this be treason, he may make the most of it.

And at least according to the OED, he's dead wrong about wogs. It doesn't accept his proposed etymology (any more than it accepts "port out, starboard home" as that for "posh"), saying that the term is of uncertain origin, and defines "wog" as "a vulgarly offensive word for a foreigner, esp. one of Arab extraction." One illustrative quote is, "King Zog Was always considered a bit of a Wog, Until Mussolini quite recently Behaved so indecently." Another is, "We have travelled some distance from the days when Wogs began at Calais." So much for the Work Order Guys.

Harry Turtledove

Dear Dr. Schmidt,

I've always liked Jerry Oltion's work, but I got an extra kick out of this story ["Slide Show," May 2006]. I went through very much the same scenario about ten years ago; my trigger was when I discovered that nobody carried the projection lamps for my slide projector any more. I finally found a source, bought an extra back-up projector, and bought what I hope is a lifetime supply. I haven't gone through the same situation on slide film yet, but there's no question that it's coming, so I've stocked up on that, too. (I've currently got about 31,000 slides, mostly of trips around the world that my wife and I have taken over the last 47 years.)

Jack E. Garrett
Monroe Twp, NJ

The author replies . . .

It's good to know I'm striking a chord with people, even if it's based on a sad note.

Jerry Oltion

Dear Stan,

I did enjoy the article "The Terrestrial Search for Extraterrestrial Life" by Catherine Shaffer [May, 2006] and learned quite a bit from it. I would however argue with some of the points made in the article.

Green is *not* a universal color for plants that photosynthesize. I grow chard in my garden that has purple leaves and photosynthesizes quite nicely, thank you. The article denies the possibility of photosynthesis using another compound than chlorophyll. Photosynthetic organisms growing on planets with a markedly different spectrum of light from their primary may find some other molecule to be more efficient. Indeed, it seems a bit strange that the peak of the solar spectrum is not utilized by chlorophyll, suggesting that even for Earth, chlorophyll may not be the most efficient molecule for photosynthesis.

Toward the end of the article, the argument is made that ammonia is unsuitable in forming membranes since it cannot form hydrogen bonds. Ammonia does have inter-molecular hydrogen bonds. If it did not, its boiling point (-33C) would be a lot closer to that of methane (-161C) since it has virtually the same molecular weight. Hydrogen bonds form between the hydrogens of one molecule and the lone pair orbitals of another molecule. Water, ammonia, and hydrogen floride all have hydrogens and lone pair orbitals and all of them form hydrogen bonds. And, all of these molecules are polar molecules. The main difference is that water can form

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interlocking three-dimensional structures with hydrogen bonds whereas ammonia and hydrogen floride can only form chains. Water can form an average of two hydrogen bonds per molecule whereas ammonia and hydrogen floride can only form an average of one hydrogen bond per molecule.

Finally, and assuming I am reading the article correctly, the author implies that one would not be expected to find a sentient life form where alternate chemistries produce much lesser amounts of energy than photosynthesis provides on the Earth. Certainly, large and mobile organisms require a lot of energy, but even on Earth, the intelligent life is not photosynthesizing, but rather consumes photosynthetic organisms for its energy. Why cannot a sulfur based alternate chemistry produce sufficient "food" to support the development of higher life forms and even sentient life forms?

Prognostications that limit the range of possibilities are often wrong.

Ken Young
Petrolia CA

Dr. Schmidt,

Catherine Shaffer's article on the search for extraterrestrial life was beautifully written and very instructive. As a chemical engineer, it has been over 60 years since my last class in organic chemistry, but she made everything easy to understand. I was immediately curious about her background and wondered if she were a tenured university professor or perhaps a senior scientist in industry.

Imagine my delight in reading Richard Lovett's Biolog and finding that she is young and pretty and happily married! What a pleasure it must be to have an intelligent, skilled wife like that, and how great it would be to have a teacher who can explain things so clearly.

Robert A. Stanton ■

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UPCOMING EVENTS Anthony Lewis

22–24 September 2006
FOOLSCAP VIII (Washington state SF conference) at Bellevue Sheraton, Bellevue, WA. Guests of Honor: C.J. Cherryh, Kage Baker. Registration: $50 until 21 September 2006, $60 at the door. Info: www.foolscapcon.org, chair@foolscapcon.org, Foolscap, c/o Little Cat Z, PO Box 2461, Seattle WA 98111-2461.

2–5 November 2006
WORLD FANTASY CONVENTION at Renaissance Hotel, Arboretum, Austin, TX. Guests of Honor: Glen Cook & Dave Duncan; TM: Bradley Denton; Editor Guest of Honor: Glenn Lord; Artist Guest of Honor: John Jude Palencar; Robert E. Howard Artist Guest: Gary Gianni. Registration: $125 until 31 July 2006; supporting $35. Info: http:// www.fact.org/wfc2006/ wfcinfo@fact.org; FACT, Inc., Box 27277, Austin TX 78755.

30 August–3 September 2007
NIPPON 2007 (65th World Science Fiction Convention) at Pacifico Yokohama, Yokohama, Japan. Guests of Honor: Sakyo Komatsu and David Brin. Artist Guests of Honor: Yoshitaka Amano and Michael Whelan. Fan Guest of Honor: Takumi Shibano. Registration: USD 180/JPY 20,000 until 30 June 2006, for thereafter. This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Nominate and vote for the Hugos. This is only the third time Worldcon will be held in a non-English speaking country and the first time in Asia. Info: www.nippon2007.org; info@nippon2007.org. Nippon 2007/JASFIC, 4-20-5-604, Mure, Mitaka, Tokyo 181-0002. North American agent: Peggy Rae Sapienza, Nippon 2007, PO Box 314, Annapolis Junction, MD 20701, USA. UK agent: Andrew A. Adams, 23 Ivydene Road, Reading RG30 1HT, England, U.K. European agent: Vincent Doherty, Koninginnegracht 75a, 2514A Den Haag, Netherlands. Australian agent: Craig Macbride, Box 274, World Trade Centre, Victoria, 8005 Australia. ◙

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